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Highway Safety Literature

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SAE: Society of Automotive Engineers, Dept. HSL, 400 Commonwealth Drive, Warrendale, Pa. 15096. Order by title and SAE report number.

TRB: Transportation Research Board, National Academy of Sciences, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

STATE OF RHODE ISLAND SPECIAL ADJUDICATION FOR ENFORCEMENT (SAFE)

Technical Summary

Annual Report

July 1975–June 1976

by

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Transportation, Administrative Adjudication
Division

and

Robert G. Ulmer, Dunlap and Associates, Inc.

ABSTRACT

The following technical summary presents the main findings of the first annual report of the Rhode Island Special Adjudication for Enforcement (SAFE) Demonstration Project.

The summary is intended for program management personnel, NHTSA Headquarters and Regional Administrative staff, Congressional staff, and state and local traffic safety specialists or field personnel who may be considering implementing administrative adjudication of traffic offenses in their communities.

TECHNICAL SUMMARY

The Special Adjudication for Enforcement (SAFE) demonstration project in Rhode Island is operated by the Administrative Adjudication Division of the state Department of Transportation. Funding for the project comes from the Office of Driver and Pedestrian Programs of the National Highway Traffic Safety Administration (NHTSA) and from the State of Rhode Island.

Following a planning period, the Administrative Adjudication Division (AAD) commenced operation on July 1, 1975. The present report deals with project development and the first year of operation, i.e., through June 30, 1976.

A. Project Objectives

Administrative adjudication in Rhode Island is based on a state law which has decriminalized most traffic offenses and created the AAD to dispose of these cases.* The overall goal of administrative ad-

judication is to improve the processing and disposition of traffic offenses in terms of consistency of sanctions, the relationship of sanctions to the circumstances of

* The offenses excluded from administrative adjudication are: driving to endanger resulting in death; driving under the influence of liquor or drugs; reckless driving; driving without a valid license or after denial, suspension, or revocation of license; leaving the scene of an accident involving personal injury or damage to an attended vehicle; driving without the consent of owner; and possession of a stolen

the violation and the motorist's driving history, and the time to disposition. In addition, previously-existing procedural difficulties which contributed to a scofflaw situation are being eliminated. The anticipated effect of these improvements will be a more positive attitude among the public toward traffic law enforcement and a lesser rate of subsequent driving problems among violators. The specific objectives of AAD are as follows:

1. Objectives Related to the District Courts

It is estimated that AAD has removed more than three-quarters of the annual traffic caseload from the District Courts. The objective with regard to the court is to provide this reduced caseload and thereby permit a reduction in backlog of other types of cases, and to permit the assignment to the District Courts of certain functions previously handled in the Superior Courts.

2. Objectives Related to Adjudication

The specific objectives of administrative adjudication are as follows:

- To implement a reliable system that permits the non-chronic offender to pay a fine by mail in minor traffic violations or, if he wishes, to contest the facts or explain the circumstances at an administrative hearing.
- To identify the chronic offender and require him to appear at an administrative hearing to adjudicate his offense.
- To make accurate and up-to-date driver histories available at hearings (after judgment) so that sanctions can be applied based on the facts of the case and on the driving history.
- To require individuals judged at a hearing to represent a possible traffic safety hazard to complete a drive retraining school as an adjunct or alternative to the sanctions imposed.
- To reduce the elapsed time from the violation to the final imposition of sanctions compared with the previously existing District Court-Registry of Motor Vehicles system.
- To provide consistent case dispositions throughout the elements of the adjudication system.

3. Objectives Related to Driver Retraining

Driver retraining schools are being operated

ing from administrative hearings. The objective of this aspect of the program is to provide an additional and non-punitive option in traffic case adjudication and thereby reduce the likelihood of further driving problems among chronic offenders.

4. Objectives Related to the General Public and the Traffic Safety System

An in-house public information effort is a part of AAD. Activities include press releases, speaking engagements, and descriptive literature. The objectives are:

- To explain administrative adjudication to the motoring public and win support for this approach.
- To improve the attitude of violators toward traffic offense adjudication.
- To explain administrative adjudication to the criminal justice system (courts, police, attorneys, etc.) and gain their support.

B. Background Information

The Rhode Island court system consists of a three-tiered structure composed of the District, Superior, and Supreme Courts. Historically, the District Courts were organized to provide a forum for the settlement of disputes among individuals. As such, the early courts were not courts of record, judges did not necessarily have to have legal training, and the principle was established that persons dissatisfied with the court's judgment could appeal and obtain a trial *de novo*.

Over the course of time, the jurisdiction of the District Courts came to include all traffic offenses, small claims and other civil cases, misdemeanor arraignments, and non-jury trials and felony arraignments. Also, the requirement was imposed that judges in the District Courts be attorneys.

During the 1960's it became apparent that the District Courts were being overwhelmed by traffic cases. The response to this, in the early 1970's, was to establish a pay-by-mail system whereby motorists could pay fines by mail for certain traffic offenses, subject to the condition that they had not been guilty of another violation in the previous 12 months.

Also during the early 1970's, various commissions were established by the legislature to study the judicial system in the state. One of these commissions became

was then emerging in New York State. This concept was studied for applicability in Rhode Island, public hearings were held and legislation to decriminalize traffic offenses and adopt administrative adjudication procedures was introduced. This initial legislation was not successful, however, primarily on the grounds of financing. There was, nevertheless, wide support for the concept as a means of reducing court caseload and because of its de-emphasis of the criminal aspect of traffic offenses and use of less formal hearings which emphasized the traffic safety aspects of the violations.

In 1973, the National Highway Safety Advisory Committee recommended the approach to traffic violation adjudication that would include classifying most offenses as infractions rather than misdemeanors or felonies, and would handle these infractions through simplified and informal administrative procedures. The Highway Safety Act of 1973 authorized the U.S. Department of Transportation to conduct demonstration projects in this area. The first Special Adjudication for Enforcement (SAFE) project was carried out in the City of Seattle. The second project is statewide in Rhode Island.

C. Development of the System

In April 1974 the state submitted a competitive proposal to NHTSA to conduct a SAFE demonstration project. An important part of this proposal was approved legislation which decriminalized most traffic offenses and authorized the establishment of AAD to adjudicate these cases. Among the major features of this legislation were:

- The specific definition of which traffic offenses are excluded from administrative adjudication.
- The provision that hearing commissioners shall be appointed by the governor for a six-year term and the authority for the chief commissioner to promulgate regulations regarding the conduct of the hearing process.
- The retention of the pay-by-mail system and delineation of the sanctions that may be imposed at AAD hearings. Also, the requirement that the Director of AAD develop and distribute a uniform summons form for use throughout the state.
- The authority to require attendance at driver

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On July 1, 1974 the state was awarded a multi-year contract to plan, develop and operate a SAFE demonstration project. The original contract called for the submission of a detailed project plan by November 15, 1974 with the completion of all activities including final reporting by April 30, 1977. This schedule was subsequently modified so that operational activities would cover the period from July 1, 1975 to June 30, 1977. Final reporting is due by October 30, 1977.

D. Summary of Work Accomplished

Actual work on the Rhode Island SAFE began in October 1974, when the Director and Technical Program Manager were appointed. From that time until the end of the year, major emphasis was placed on staff recruiting, obtaining facilities and equipment, and on soliciting subcontractors for the data system development and evaluation phases of the effort. In addition, planning was undertaken for the transfer of the Violation Bureau from the District Court to AAD and on the structure and content of the driver re-training activity.

By early 1975, major staff positions had been filled and subcontracts completed. The next several months were a period of intensive planning and development, pointing toward the required start date of July 1, 1975. Among the major activities in this period were:

- The completion of the project's detailed plan, which specified goals and objectives, organization and staffing, functional flow and task allocations, and budget.
- Development and publication of the administrative procedures to be employed by AAD.
- Design and production of the forms, including summonses, to be utilized.
- Introduction and passage of legislation making technical changes to the original AAD act, modifying the pay-by-mail fine schedule, and authorizing the transfer of the Violation Bureau.
- The creation of a three year, computer-based history of driver violations, accidents, and

the following characteristics: The Administrative Adjudication Division has been established within the Rhode Island Department of Transportation at the same organizational level as the Registry of Motor Vehicles. The AAD Director is an Assistant Director of Transportation.

The AAD is composed of a management staff and four operating sections. These are:

1. Violation Section—responsible for issuance and control of traffic summonses to all police departments in the state. Responsible for receipt and recording of all mail responses to summonses.
2. Hearing Section—responsible for the conduct of all hearings required to adjudicate the decriminalized traffic violations.
3. Driver Retraining Section—responsible for the conduct of driver retraining schools for persons referred by the Hearing Section.
4. Data System Section—responsible for data processing of the major transactions involved in AAD. Included are maintenance and generation of driver histories, fine accounting, summons control, verification of eligibility to pay by mail, generation of warning/suspension notices to motorists who fail to comply with AAD, and hearing docket scheduling and notification of motorists.

The system operates in the following manner: All traffic offenses in the state, except parking, the violations not decriminalized, and local ordinances which, in some communities, are heard by a municipal court, are under the jurisdiction of AAD.

When a *misdemeanor* offense is detected, the offender is arrested and arraigned. As was the case prior to AAD, such violations are heard in the District Courts. The dispositions of these cases are then reported to the Registry of Motor Vehicles and to AAD which updates the automated driver history files implemented by the project.

In all other violations, the police officer issues a traffic citation using a standard form provided by AAD. If the offense is not eligible for payment by mail or there are multiple offenses arising from the same incident, the officer indicates to the offender that a hearing will be required and that he will be

appear. Copies of all citations are forwarded within 48 hours from the issuing department to the Violation Section of AAD. Here they are converted to data processing readable form and entered into the project's data system. For violations requiring a hearing, this process generates a hearing notice to the offender and places the case on the hearing docket.

In violations that are eligible for payment by mail, the officer enters the applicable fine on the face of the citation, using a standard fine schedule. The motorist is given a copy of the citation and informed that he may pay by mail if he chooses to admit the violation and meets the conditions noted on the summons.

Copies of these summonses are forwarded to the Violation Section where they are checked for accuracy and completeness and then entered into the data system. This process checks for eligibility to pay by mail (i.e., that the driver has not had another violation in the previous 12 months). If the driver is eligible, a "pay-by-mail card" is punched and returned to the Violation Section. Also, the fact that the summons has been issued is recorded in the data system's Outstanding Summons File.* If the motorist is not eligible to pay by mail, the case undergoes hearing scheduling.

The Violation Section receives mail responses to summonses on a daily basis. These consist of the motorist's completed copy of the citation along with payment as appropriate. The mail-ins are matched with the pay-by-mail cards previously generated and the fact of payment entered into the data system. In cases where the respondent has indicated he wishes to contest the case, a hearing notice is generated to the individual and the case entered on the hearing docket.

Payments received by mail are removed from the Outstanding Summons File and recorded as disposed cases. Where payment is not received within 14 days of the violation, the data system generates a warning notice informing the person that if he does not respond within 10 days his driver's license will be suspended. An AAD suspension also prevents persons from renewing their licenses. This is done to maximize compliance with AAD regarding summons disposition.

Persons are required to attend an AAD hearing to adjudicate a traffic offense in four circumstances.

* All citations are serially numbered and must be accounted for. The citation control system performs this function.

charged with multiple violations of the same summons; or (4) the motorist is eligible to pay by mail, but wishes to contest the case.

The data system generates periodic listing of persons requiring hearings. Such cases are manually scheduled for the next available hearing session at the site closest to the issuing police department. The schedule is re-entered into the data system which then generates hearing notices, dockets, and driver history abstracts for the cases involved.

AAD hearings are conducted by three full time and one part-time hearing officers (Commissioners). These individuals, along with clerical and security staff, hold hearings at various sites on a periodic basis throughout the state. Nominal scheduling is 60 cases per day at each site.

Persons are scheduled on a particular day for a 9 a.m., 11 a.m., or 2 p.m. hearing session. At the beginning of a session the Commissioner makes brief opening remarks, explaining the procedures to be followed and emphasizing the traffic safety aspects of the proceedings. Each motorist is then heard individually, in turn. The Commissioner reads the violation charged and asks the motorist how he pleads. Three pleas are possible—Admit the Violation, Admit the Violation with Explanation, or Deny the Violation. (In the latter plea the case is rescheduled to a future date when the officer who issued the summons appears.)

Following a plea of Admit, the Commissioner may question the motorist regarding the violation and then sustain the charges. Where the plea is Admit with Explanation, the Commissioner will listen to the explanation and then sustain or dismiss the charge.

When charges are sustained, the Commissioner reviews the driving record with the motorist and then imposes sanctions. Three types of sanctions are possible singly or in combination. These are a monetary fine up to \$500, license suspension of up to one year duration, and referral to a driver retraining school.

AAD hearings are intended to be less formal than court appearances, with motorists given the opportunity to explain the circumstances of the violation even if they do not wish to deny the charge. Also, insofar as possible the Commissioners attempt to em-

phasize to provide a record of the outcomes. Persons failing to appear at required hearings have their licenses suspended until they comply with the hearing order.

AAD hearings are tape recorded so that a record is available if an appeal is taken. Appeals are first heard by an AAD Appeal Board. Beyond this, appeals may be taken to the court system.

Persons who are referred to driver retraining have their records forwarded to the Driver Retraining Section which conducts a single meeting, General Education Session (GES), and the Defensive Driving Course (DDC). The decision regarding whether GES or DDC attendance is required may be made either by the Commissioner at the time of the hearing or by the Driver Retraining Section following receipt and review of driver records. Motorists are charged a tuition to offset the costs of the retraining schools.

E. Results of Activities

The administrative adjudication of traffic offenses became an operational reality on a statewide basis in Rhode Island on July 1, 1975. During its first year of operation, AAD disposed of approximately 65,000 traffic summonses, with 49,626 of these having been paid by mail and the remainder adjudicated at hearings. The pay-by-mail summonses generated fines in the amount of \$1,089,682, of which \$113,761 came from follow-up procedures implemented by the project.

The volume of summonses paid by mail declined by approximately 14 percent compared to the 12 months prior to the project, with this being due to AAD's ability to enforce the condition that a motorist can pay only one summons by mail in a 12-month period.

Analysis of the violations paid by mail indicates that speeding charges account for 78 percent of all summonses. Seven of 51 violations which can be paid by mail (speeding, disobedience to devices, conditions requiring reduced speed, disobedience to stop and yield signs, operating left of center, and overtaking where prohibited) account for 94 percent of the pay-by-mail volume.

Examination of the characteristics of persons paying summonses by mail shows that 73 percent were state residents, while the remainder held out-of-state licenses.

Young drivers under the age of 25 were overrepresented in summonses paid, in comparison to their numbers in the licensed driver population. Males accounted for 78 percent of those paying by mail. Some differences were noted in the types of violations involved depending on motorists' residence, age, and sex.

At the end of June 1976 there were 3,742 persons who had received summonses and were eligible to pay by mail, who had not responded. These persons have had their driver licenses or rights to operate in the state suspended.

The AAD Hearing Section is composed of three full-time and one part-time Commissioners and security and clerical personnel who sit at various sites around the state to adjudicate violations requiring a personal appearance. During the first year of operation, 14,982 summonses containing 16,254 violations were disposed of in this manner, with this total being an increase of some 70 percent in the number of personal appearances required, compared to the 12 months prior to AAD.

Approximately 56 percent of the hearings were required because the motorists were not eligible to pay by mail, while 10 percent involved offenses which cannot be paid by mail. Less than two percent of the hearings came about from people who were eligible to pay by mail who wished to contest the case or admit with explanation.

Five percent of the AAD hearings involved contested cases requiring the appearance of the issuing officer. This figure is a reduction from the nine percent contested rate in the last year of court jurisdictions over the relevant traffic violations.

The sustained rate in contested cases was 54 percent and was 85 percent in uncontested cases. Both of these rates are significantly higher than in the courts in the year before AAD.

Variations were found to exist in the sustained rates of various violations and among the hearing sites. It was also found that certain violations (e.g., those related to an accident) were more likely to be contested.

Fines for similar violations were found to have been levied with a high degree of consistency among the hearing sites. The average fine in uncontested violations was higher under AAD than the courts; the reverse was true in contested cases.

Referrals to Driver Retraining were made in 22 percent of the cases disposed of at hearings. Variations in referral rate were found to exist among the

hearing sites, with these differences related to variations in driver history and residence and policy with regard to referral as an alternative to imposing a monetary sanction.

The median time from issuance of the summons to hearing disposition was approximately 45 days in uncontested cases and over 90 days in contested cases. The 45 day figure is substantially higher than the less than 30 day median for the courts in uncontested cases with this being due to the AAD initiated scheduling system. No data are available on the time to court disposition of contested cases.

Rhode Island residents made up 93 percent of those whose cases were disposed of at hearings with this proportion being significantly higher than the 73 percent figure for summonses paid by mail. This difference is due to Rhode Island residents being more likely to be ineligible to pay by mail (i.e., have a prior violation) and to be more likely to receive a summons for an offense that cannot be paid by mail. No differences were found to exist in the sustained rates as a function of residence.

Approximately 87 percent of the persons whose cases were adjudicated at hearings were males, with this proportion being higher than the 78 percent figure for males who paid summonses by mail. Again, the underlying reasons are the greater likelihood that males are ineligible to pay by mail and to be issued summonses for offenses which require a hearing. Differences were found in the sustained rates for males and females charged with like violations. Also, the sustained rates for males and females differed among the hearing sites.

Young drivers were found to be overrepresented among those whose cases were disposed of at hearings compared to the licensed driver population and to those who paid summonses by mail. Significant differences related to age were found in the likelihood of having uncontested charges sustained, with older drivers being more likely to have charges dismissed. Drivers who contested cases were found to be somewhat older than those who did not contest.

Samples of motorists leaving hearing sites showed generally positive attitudes, with 93 percent of the respondents saying they had been treated fairly. Approximately 41 percent of the motorists said there would have been a better time for the hearing. However, there was not unanimity of opinion about when that time would be.

Appeals of hearings are taken first to an AAD Appeal Board and then to court. During the first year 35 appeals were filed, with this representing a rate of about 13 percent of all contested hearings where the charges were sustained. To date, two appeals have continued into the court system.

Because of the relatively short period of operation and some problems associated with the data base, it is believed to be premature to address the topic of recidivism at this point. An encouraging finding has been that the average elapsed time between offenses, among those who went to more than one hearing, was 105.4 days compared with 91.9 days for multiple violations requiring court appearances in the year before the project.

The non-compliance rate (failure to pay by mail or appear at a hearing) was found to be higher for out-of-state residents than among those holding Rhode Island licenses. A recent policy of adjudicating through the mail out-of-state residents who do not appear at hearings has had a compliance rate of 50 percent.

The AAD Data System has been implemented at the state's central data processing installation. Consisting of 26 functional sub-systems made up of 48 programs, the system supports the major activities of AAD, including summons and fine accounting and control, determination of eligibility to pay by mail, hearing scheduling generation of suspension notices, and the production of various reports. The basis of the system is in driver-based files of violation, accident, suspension, and driver retraining history.

The system was developed under subcontract by a commercial firm. Unfortunately, the development of the system did not proceed smoothly. The contractor was more than a year late in installing certain capabilities and various programming errors continue to be detected. The effect of this was that AAD was forced to work with various "stop gap" methods during much of the first year. This led to various procedural errors which have created gaps and omissions in the data system. While these are in the process of being corrected, the full operational value of the data system has not yet been attained.

The typical monthly charges for data processing were \$8,200, of which about 62 percent came from computer time and the remainder from keypunching.

Operational costs during the first year amounted to \$369,814, with the major cost element being the hearing process. It is estimated that the unit cost of disposing of a summons paid by mail is \$2.78 while the unit cost of a hearing disposition is \$16.82.

Cost comparisons with the District Court dispositions of traffic cases are difficult to make because of limited data. At a gross level, the average court cost of disposing of a case, regardless of type, was at least \$19.56. The AAD hearing cost of \$16.82 is cost competitive in this comparison.

AAD has had a major impact on the court system. Removal of most traffic cases from the court's jurisdiction has brought about a 17 percent reduction in the backlog of cases and has permitted the courts to take on new functions. Thus, AAD has helped to alleviate court caseload and has permitted progress to be made toward a restructuring of the court system.

AAD has also provided savings to the police departments through the reduced need for police prosecutors at arraignment of traffic cases, because officers spend less time at contested hearings than at contested court cases, because of reduced clerical tasks due to the elimination of warrants in most traffic cases, and because of the elimination of the *capias** as the follow-up to defaulted court appearances.

As a part of the administrative adjudication of traffic violations, two types of driver retraining programs are being conducted for motorists having charges sustained at hearings. These are: (1) a General Education Session, consisting of a single two-hour didactic presentation and, (2) the Defensive Driving Course developed by the National Safety Council.

During the first year of operation, 44 sessions of the GES course were held. A total of 1,537 persons were assigned to attend, with 1,484 graduating, while 53 failed to appear. A total of 22 cycles of DDC were conducted, with 681 persons graduating, while 41 failed to attend.

Evaluation of the courses showed that both produced measurable increases in knowledge among the students.

No significant differences were found in violation recidivism, compared with randomly selected control groups.

F. Potential Applications

The administrative adjudication system installed under the SAFE demonstration in Rhode Island is a workable one which is likely to be retained in its present form on a permanent basis. Toward this end, a budget submission will be made to the 1977 legislature for state funding for fiscal year 1978.

There are several advantages found in the structure of SAFE in Rhode Island. Among these are centralized record keeping, flexibility in hearing scheduling, easy access to cooperating agencies such as the Registry of Motor Vehicles, and simple promulgation of policies to all elements of the organization.

Whether the model employed in Rhode Island could be transferred to other states is likely to be determined by the scale of the required operation (i.e., size and population of the state). That is, it is suspected that in larger states some regional organization would be more desirable than a totally centralized one. However, there is likely to be a tradeoff between the advantages of a regional (e.g., county level) set up and the proliferation of management and support positions probable in such a structure.

The Rhode Island SAFE has employed system-initiated hearing scheduling rather than conducting hearings on a walk-in basis. This decision was based on two considerations. First was the importance attached to the availability of the driver history at the hearing site. In the absence of a real-time data pro-

cessing system, no realistic way could be found to make the driver history available and service "walk-ins."

The second consideration was that system-initiated scheduling permitted the adjustment of schedules to meet local variations in hearing loads. None of the AAD hearing sites meets on a full-time basis. Rather, the Commissioners, clerks, and security officers change locations on different days of the week. Except for the central (Providence) site, all hearings are held in donated facilities. This has been possible because the demand for space at any one location is not extensive. Using this approach, it is possible to hold hearings in relatively small communities, rather than requiring motorists to travel to more distant full-time regional centers.

Other states may find walk-in rather than system-initiated scheduling desirable. If the use of up-to-date driver records is a part of this approach, there would appear to be an accompanying need for a large scale telecommunications and real-time computer operation.

The decision regarding site scheduling and locations is believed to be an important one. Major population centers may require full time hearing locations. The questions of space availability and cost would then take on more importance than they have in Rhode Island. Some combination of full-time and part-time sites could be a solution in a statewide program where population densities vary.

ABSTRACT CITATIONS

FORMAT OF ENTRIES IN HIGHWAY SAFETY LITERATURE

NHTSA accession number ----- HS-013 174

Title of document ----- **MAXIMUM BRAKE PEDAL FORCES PRODUCED BY MALE AND FEMALE DRIVERS**

Abstract ----- The object of this research was to obtain data concerning the maximum amount of brake pedal force that automobile drivers were able to sustain over a period of ten seconds. Subjects were told to apply the brakes in the test car as they would in a panic stop, and to exert as much force as possible on the pedal over the entire ten second test period. A total of 84 subjects were tested, including 42 males and 42 females. Test results indicated that there is a wide distribution of values which characterizes the pedal force that the subjects were able to generate. Male subjects produced generally higher forces than did females. Over half the women tested were unable to exert more than 150 lbs. of force with either foot alone, but when both feet were applied to the pedal, force levels rose significantly.

Personal author(s) ----- by C. R. VonBuseck

Corporate author (or author's affiliation) ----- General Motors Corp.

Publication date; pagination ----- 1973? ; 18p

Supplementary note ----- Excerpts from Maximum Parking Brake Forces Applied by Male and Female Drivers (EM-23) BY R. L. Bierley, 1965, 2 included.

Availability ----- Availability: Corporate author

NHTSA accession number ----- HS-018 924

Title of document ----- **NATURAL FREQUENCIES OF THE BIAS TIRE**

Abstract ----- The lowest natural frequencies of a bias tire under inflation pressure are deduced by assuming the bias tire as a composite structure of a bias-laminated, toroidal membrane shell and rigorously taking three displacement components into consideration. The point collocation method is used to solve the derived system of differential equations with variable coefficients. It is found that the lowest natural frequencies calculated for two kinds of bias tire agree well with the corresponding experimental results in a wide range of inflation pressures. Results of the approximate analysis show that the influence of the in-plane inertia forces on natural frequency may be considered small, but the influences of in-plane displacements are large, particularly on the natural frequency of the tire under low inflation pressure.

Personal author(s) ----- by Masami Hirano; Takashi Akasaka

Journal citation ----- Publ: Tire Science and Technology v4 n2 p86-114 (May 1976)

Publication date ----- 1976; 6refs

Availability ----- Availability: See publication

LONGITUDINAL STUDY OF CALIFORNIA DRIVERS ACCIDENT FREQUENCIES I: AN EXPLORATORY MULTIVARIATE ANALYSIS. FINAL REPORT

This longitudinal study attempts to develop an optimum accident prediction system using nine-year driving history records of a large sample of California drivers and biographical and mileage exposure data collected through a questionnaire survey. An exploratory nonconcurrent regression analysis (without questionnaire data) on a three-year accident interval produced a prediction equation with 29 predictor variables and a multiple correlation coefficient of 0.271. Among the variables which discriminated between accident and non-accident drivers were prior conviction frequencies and prior accidents: drivers with prior accidents and convictions were more likely to have accidents in subsequent time periods. Two probabilistic models, the simple Poisson and the negative binomial, were employed to fit the observed accident distributions of three non-overlapping three-year intervals for the same group of drivers, with the best result obtained by the negative binomial in the last triennium. The report also delineates a conceptual framework of the subsequent phases of the entire prediction system generation process.

by K. W. Kwong; J. Kuan; R. C. Peck
Department of Motor Vehicles, Office of Program Devel. and Evaluation, P.O. Box 1828, Sacramento, Calif. 95809
Contract HPR-PR-1(12)-B0149-1A
Rept. No. CAL-DMV-RSS-76-55; 1976; 56p 15refs
In cooperation with the U.S. Dept. of Transportation, Federal Hwy. Administration.
Availability: California Div. of Highways, Scaramento, Calif. 95807

HS-020 690

THE INTERNATIONAL ENERGY SITUATION: OUTLOOK TO 1985

For major energy consuming countries the total energy demand was estimated on two basic factors: the rate of economic growth and the effect of present conservation measures. In the absence of greatly increased energy conservation, projected world demand for oil will approach productive capacity by the early 1980's and substantially exceed capacity by 1985. The underlying supply problem will be masked during the next few years because of greatly increased oil production from the North Sea and Alaska, causing the demand for oil from the Organization of Petroleum Exporting Countries (OPEC) to stabilize at current levels through 1979. Between 1979 and 1985, increasing world demand and stagnating oil production in the major consuming countries, including the USSR, will result in increased reliance on OPEC oil. By 1985, the demand for OPEC oil is estimated at 47 to 51 million barrels a day (b/d), and, even if all other OPEC countries produce at capacity, Saudi Arabia will be required to produce between 19 and 23 million b/d if the demand is to be met. At present, Saudi Arabia's capacity is 10 to 11 million b/d, and the 1985 projected capacity is at most 18 million b/d. With the present production expansion plans of the Saudis, their excess production capacity will be exhausted by 1983, and with it their ability to act as a price moderator in OPEC. Although Saudi Arabia has the reserve potential to meet increased demand between now and 1985, they are already committed to an am-

bitious industrialization program which is stretching management, labor supply, and logistic capabilities extremely thin. Also, wanting to conserve their valuable resource and having no immediate need for more money, they have no economic incentives to expand production. Alternative oil supplies are not likely to come on stream rapidly enough to significantly alter the situation and non-oil energy supplies cannot be counted on to appreciably relieve the problem between now and 1985.

Central Intelligence Agency
1977; 20p
Availability: GPO

HS-020 691

THE CRASH HELMET. STATISTICAL SURVEY OF ACCIDENTS INVOLVING INJURED MOTORCYCLISTS WITH OR WITHOUT CRASH- HELMET: 1973-1975

Statistical data collected between 1973 and 1975 covering all the accidents which involved motorcyclists in Belgium revealed only a narrow margin between the percentage of victims with or without a crash helmet, comparing the number receiving slight injuries, severe injuries, and the number killed. A crash helmet is not a remedy for preventing injuries; even if the crash helmet protects the head, the road-user involved in an accident often incurs numerous injuries all over the body, any of which can cause death. Interpreting the actual prevention statistics of crash helmet use is difficult due to the inability to determine whether the helmet was worn correctly. Other problems inherent in wearing the crash helmet are the weight of the helmet which may cause fatigue, possible obstruction of vision, and the various psychological implications wearing the helmet can produce.

by R. Van Butseele
Ministere des Communications, Belgium
1976?; 21p
Availability: Ministere des Communications, 62 rue de la Loi, 1040 Brussels, Belgium

HS-020 692

PREDICTING THE BRAKING PERFORMANCE OF TRUCKS AND TRACTOR-TRAILERS. PHASE 3 TECHNICAL REPORT. APPENDICES A, B, C, D, E, F

Three digital computer programs for predicting the braking performance of commercial highway vehicles are applicable to straight trucks, tractor-semitrailers, and doubles combination vehicles and consist of a main program, subprograms for input, output, and FCT1, and a group of support programs, all written in FORTRAN IV. Subroutines are tabulated and flow diagrams given. Individual suspension models are made for single-axle, walking beam, basic four spring, four spring with spring-type torque rods, four spring with long load lever, multiple torque rod four spring, MTRFSS with leaf spring-type lower torque rod, and air suspension types. The general format of the models is that all individual forces are generalized into vertical, horizontal, and moment, then passed from the suspension subprogram to the main program for the sprung mass calculations. Thus, a single set of sprung mass equations

is used regardless of the suspension types being simulated; both static and dynamic models are discussed. The brake models allow for specification of the following brake types: no brakes, S-cam, single or dual wedge, duo-servo, duplex, and disc. Calculations are given for brake torque and for three types of brake shoes: pinned leading, pinned trailing, and leading. Three sets of antilock data are listed along with corresponding pressure and wheel slip time histories representative of each data set. An optional model of the fifth wheel coupling includes a fixed spring rate, damping, and a matrix solution option by which the fifth wheel is no longer modeled as compliant but as a rigid coupling in all directions.

by C. B. Winkler; J. E. Bernard; P. S. Fancher; C. C. MacAdam; L. K. Johnson
University of Michigan, Hwy. Safety Res. Inst., Huron Pkwy. and Baxter Rd., Ann Arbor, Mich. 48109
Rept. No. UM-HSRI-76-26-2; 1976; 157p 5refs
Project 360932, Truck and Tractor-Trailer Braking and Handling.
Availability: Corporate author

HS-020 693

PROFESSIONAL DRIVERS: PROTECTION NEEDED FOR A HIGH-RISK OCCUPATION

Although "on the job" motor vehicle deaths number more than 4,000 annually in the U.S. and comprise nearly one-third of all work-related deaths, the Department of Labor has set no standards relating to on-the-road safety of the millions of workers whose jobs entail large amounts of driving, and Department of Transportation standards affecting occupational safety cover only drivers in interstate commerce. Drivers of some commercial vehicles, such as heavy trucks are at special risk of injury because trucks have usually been exempted for many years from Federal motor vehicle safety standards (e.g. for brakes and seatbelts) designed to prevent crashes or protect occupants in crashes. Observations based on a series of 150 fatal crashes involving tractor trailers illustrate the need for better protection of this large population of high-risk workers. Clarification of responsibility within the various Federal agencies and application of available knowledge and technology is essential. Design of highways and roadsides should take into consideration the needs of large, heavy trucks.

by Susan P. Baker; Jackson Wong; Robert D. Baron
Publ: American Journal of Public Health v66 n7 p649-54 (Jul 1976)
1976; 26refs
Presented at 103rd Annual Meeting of the American Public Health Association, Chicago, Nov 1975.
Availability: Funded by the Insurance Inst. for Hwy. Safety and the Maryland Medical-Legal Foundation. See publication

HS-020 694

EXHAUST EMISSION TEST VARIABILITY

The major sources of emission test variability have been identified by an approach consisting of designed experiments on vehicles and a computer simulation of emissions. In order to achieve a reduction in variability and a better correlation between measurement systems on different test sites, diagnostic aids including a repeatable car, a driver evaluator, static gas check, analyzer system check, total torque tester, and critical flow orifice kit were used. From an experiment consisting of multiple tests on four vehicles, an estimate of the

limits of variability due to measurement error and within-vehicle variability is established at plus or minus 39% of the mean for hydrocarbons (HC), plus or minus 50% of the mean for carbon monoxide (CO), plus or minus 15% of the mean for oxides of nitrogen (NOx), and plus or minus 9% of the mean for carbon dioxide (CO2). This magnitude of variability can vary dependent on the type of vehicle, measurement system, and environmental conditions. The vehicle, driver, and ambient conditions affect HC and CO variability significantly. On the other hand, NOx and CO2 variability is influenced to a great extent by the differences in vehicle loading. However, the importance of any one of the sources of variability cannot be ignored, especially when an A-B comparison is made between two tests.

by Wiplove K. Juneja; David D. Horchler; Harold M. Haskew
General Motors Proving Ground, Milford-Vehicle Emission Lab., Milford, Mich.
Publ: SASI-76-2632, "Air Pollution Measurement Accuracy as it Relates to Regulation Compliance. Speciality Conference," 1975 New Orleans p185-217
1975; 7refs
Presented at Air Pollution Control Association Speciality Conference, New Orleans, 26-28 Oct 1975.
Availability: Reference copy only

HS-020 695

TOWARD 2000: OPPORTUNITIES IN TRANSPORTATION EVOLUTION: FINAL REPORT

Possible directions of evolution for the nation's transportation system and research and development strategies are proposed, and population and demographic trends are briefly examined, with conjectures about the future. Transportation opportunities are outlined in the areas of urban, intercity and private automobile transportation, as well as freight systems, consideration being given to cross-cutting issues such as decisionmaking. The necessity for well integrated transportation systems with good methods for intermodal transfer is emphasized. The relationship of transportation to resource consumption and the quality of life indicates that minimizing energy consumption is often incompatible with either minimizing total costs or maximizing the output of labor and capital. An important aspect of an energy-efficient system is the load factor, which is increased by speed. A prerequisite of any new transportation system is that it meets society's environmental standards as well as those of reasonable safety. Different transportation characteristics have different costs as well as different implications for spatial organization of dwellings and political, social and economic institutions. Spatial organization influences quality of life: social and economic interaction, access to employment, stores, recreation, etc. The ideal of the future is to find ways of creating and perpetuating high density developments which are desirable for superior ambience, not economic necessity. Transportation technology is envisioned in two scenarios: a resource-constrained, sluggish economy and a healthy economy of short-lived energy shortages and economic dislocations. Five programs believed to be appropriate for balanced research and development include an urban innovations experimental program, an integrated road/vehicle program, an advanced intercity network study, a freight system evolution study, and a multipurpose fixed guideway technology

gy program. Appendix A presents a conceptual paradigm, describing the role of transportation in the "quality life."

by J. D. Ward; K. L. O'Leary; B. Bartholow; S. C. Chu; A. B. Linhares; D. C. Ryan, Jr.; D. J. Maio
Department of Transportation
Rept. No. DOT-TST-77-19; 1977; 152p 65refs
Rept. for Jan 1976-Jan 1977.
Availability: NTIS

HS-020 696

SURVEY OF THE PERFORMANCE OF INFANT AUTO RESTRAINT SYSTEMS SOLD IN THE UNITED STATES AND CANADA. FINAL REPORT

Dynamic test data are presented on infant devices specified for use in automobiles. The tests were performed on an impact sled capable of simulating a crash. The sled operated on the rebound principle, achieving a desired velocity change by reversing its direction of motion during the impact event. The infant restraint system was mounted in the center position on a 1974 GM bench-type automobile seat. Sears Type I seat belts were used. A 15 lb plus or minus 3 lb belt preload was used where possible. The test subject was the six-month-old Department of Transportation infant crash simulator (CAMI). The data were recorded simultaneously on a Honeywell 7600 GM tape system and on a Honeywell 1612 Light-beam oscillograph. Photoinstrumentation consisted of high speed (100 fps) 16 mm motion picture camera to the side, front and overhead, and a sequence Polaroid camera. The transducer data and the motion picture data were marked simultaneously by a timing pulse generator at 10 msec intervals. Sled velocity was monitored just prior to impact. Of 21 dynamic impact tests, three were 30 mph, 23 G front impacts, seven were 20 mph, 17 G 60° oblique impacts, three were 20 mph, 17 G lateral impacts, and eight were 20 mph, 17 G rear impacts. Seven frontal tests and three lateral tests were reported on which were run at an earlier time for various companies. The results give head and seat excursions, belt loads as well as sled parameters. Detail test results are given as well as a summary data sheet on all tests.

by R. L. Stalnaker
University of Michigan, Hwy. Safety Res. Inst.
Rept. No. UM-HSRI-77-21; 1977; 163p
Rept. for 15 Mar 1977-Apr 1977.
Availability: Canadian Standards Association, 178 Rexdale Blvd., Rexdale, Ontario, Canada M9W1R3

HS-020 697

THE HIDDEN CAUSE OF BEARING FAILURE

A new analytical approach for checking bearings gives the equations and calculations necessary for modeling cage motion and relating the bearing design and operational conditions to potential cage instability. Using this approach, a bearing design can be checked before it is put into service, and bearings that fail consistently can be studied to determine whether cage instability is the underlying cause of failure. Signs of instability include intermittent torque and characteristic patterns of circumferential wear inside the rolling-element pocket.

by J. W. Kannel; D. K. Sneedier
Publ: Machine Design v49 n8 p78-82 (Apr 1977)
1977
Availability: See publication

HS-020 698

SAFETY IN HIGHWAY WORK ZONES: A MATTER OF ETHICS

Safety at highway construction and maintenance zones is too often overlooked; only California has done any real work in the field. The California Department of Transportation (DOT) found a dramatic increase in the fatal accident rate in construction zones, and projected 1,340 accidents could be prevented with improvements in safety regulations in highway work zones. Focus is needed on how highway engineering professionals charged with a public trust can be held accountable to the public they are supposed to serve. As an example, a recent investigation is reported of a 22 mile long construction zone on a heavily traveled, urban, interstate route in an Eastern seaboard state where three persons lost their lives when their vehicle collided with fuel containers inside the construction area, and both the state highway engineer and the resident engineer for the project reported that there were no problems with accident prevention facilities used on the roadway. The NTSB cited hazards along the 22-mile construction zone and recommended their elimination to the Federal Highway Administration (FHWA) and the state in question. The hazards were as follows: faint lane markings, obsolete lane markings, lane markings indicating transitional lanes on the shoulders too abrupt for the speed limit, the use of timber barricades considered both obsolete and dangerous, unprotected stored materials, the presence of construction materials and debris reducing the effectiveness of bridge and guard rails, shoulders nonexistent or inadequate, excavations and barriers adjacent to roadway where work is not presently being done, and poor traffic control on temporarily closed lanes. Only after substantial efforts by the Center for Auto Safety in coordinating various groups and after a suit was filed in 1976 by the AFL-CIO and several individual complainants against the FHWA and the responsible state did improvements begin to appear. Many such dangerous conditions are ignored by public officials who designate the responsibility to the inattentiveness of the driver. However, public agencies should show greater concern for learning more about how the driver functions under changing environments and various levels of stress, physical and mental conditions, and how the highway can more safely accommodate a wider range of human differences with allowance for momentary failures. Since it does not appear that ethical standards are individually assumed, uniform ethical practices should be established through legislation, possibly through the licensing of all engineers both public and private.

by Roy W. Anderson
Publ: Traffic Engineering v47 n5 p26-9 (May 1977)
1977
Availability: See publication

HS-020 699

WHAT'S WRONG WITH HIGHWAY DESIGN?

In 1973 the Center for Auto Safety, founded in 1969 by Consumers Union and Ralph Nader, carried out a study of the new Federal-aid highways to find out if recognized roadside hazards are now being avoided. It was found that the roadside obstacles on new highways, both interstate and non-interstate, included many of the serious safety hazards that the book "Highway Design and Operational Practices Related to Highway Safety" has previously condemned. No steps had been taken to implement the book's recommendations; the operating personnel of many state highway departments had

seemingly not been exposed to an adequate training program in principles of safe roadside designs; programs of research on new safety devices were inadequate, as was the system for implementing the results of safety research. Reasons for this failure are set out and documented by the Center in "The Yellow Book Road: The Failure of America's Roadside Safety Program." To demonstrate the validity of the charge, researchers inspected and photographed the highways in 17 states; those photographs are presented, with discussion. Emphasis is placed on the prevalence of serious safety errors in new highway projects and the need for a comprehensive, hardhitting program for correction.

by Arthur Delibert

Publ: Traffic Engineering v47 n5 p21-5 (May 1977)
1977; 49fs

Condensed from presentation to American Assoc. of State Hwy. and Transportation Officials' Design Com., Birmingham, Ala., 19 Nov 1976.

Availability: See publication

HS-020 700

LIABILITY AND HIGHWAY-SAFETY PRACTICES

In the field of liability for errors in highway construction, the present trend towards larger awards by the courts to plaintiffs in highway accidents is examined. Twenty-two cases reported in recent years are reviewed and the reasons underlying the judgments analyzed. Basic to the discussion are the nondelegable duty of the State to maintain its highways in a reasonably safe condition for travel, and the principle that a motorist whose attention has not been called to an obstruction or peril in the highway has the right to presume that the roadway is reasonably safe for ordinary traffic. When notice of the existence of a defect has been given the responsible authority and no action within a reasonable time has occurred, liability will follow. What constitutes reasonable diligence in repairing defects depends upon the circumstances of each case. At construction sites, liability may attach not only to the State but to the contractor. The element of design defect continues to occur, but the general immunity from liability remains intact for pure design defect; however the courts have begun to find that in these cases there may also be construction defects. Photographs, motion pictures, traffic control device manuals and testimony of the investigating officer as well as expert witnesses are of sufficient probative value for a jury to find negligence. The 1976 case of Ehlinger vs. State in Iowa is cited as an outstanding example of the results of a failure to maintain standards.

by David C. Oliver

Federal Hwy. Administration, Office of Chief Counsel,
Washington, D.C.

Publ: Traffic Engineering v47 n5 p30-5 (May 1977)
1977

Availability: See publication

HS-020 701

A REVIEW OF THE SAFETY HAZARD DUE TO POOR HEALTH, DRUGS, AND THEIR INTERACTION

The safety hazard of a medical condition cannot be evaluated without also considering the degree to which that hazard may be modified by the use of therapeutic drugs. On the other

tries to determine the performance impairment produced by a drug without also considering the reason for taking the drug and the degree to which the drug modifies a preexisting medical hazard. Accident-involved drivers consist of those involved in fatal accidents and those in nonfatal accidents; the lower accident survival rate (ASR) in the fatal accident group is likely to be improved by the use of therapeutic drugs. In the non-fatal group impaired driving performance is the most significant hazard. Some of the therapeutic drugs, specifically those that depress the central nervous system, tend to impair driving performance. This is likely to lead to daytime, nonfatal accidents. Chronic alcoholism is likely to lead to health impairment and lowered ACER rate, and acute alcoholism is likely to impair driving performance. Recommendations are for research programs on survival rate in alcohol-involved accidents; the identification of the low ASR subject by means of objective medical signs; and disseminating information to the public and medical profession, supplemented by directions, about when a low ASR subject should abstain from driving, and when there should be special restrictions on driving at night, for long distances, etc. If the appeal for voluntary driving restrictions should be ineffective, enforced restrictions should be considered. Special emergency measures should be developed to assist the low ASR accident victim during the critical post-accident hours.

by Fred B. Benjamin

National Hwy. Traffic Safety Administration, Washington,
D.C.

Publ: Human Factors v19 n2 p127-37 (1977)
1977; 309fs

Availability: See publication

HS-020 702

TRUCK ELECTRICAL SYSTEMS

Basic information, design criteria, and state-of-the-art details are given for the newer maintenance free truck electrical systems, including batteries, ignition systems, lighting, and vehicle instrumentation. Truck batteries are secondary cells usually of lead-acid, nickel-cadmium, or nickel-iron. Battery performance is affected by failure to maintain a full charge, and by temperature and vibration. Recent developments have improved battery service life by substitution of small percentages of calcium for antimony as an alloying agent. Today's truck generators are integral assemblies made possible by semiconductors and integrated electronics. Knowledge of the electrical loads of typical devices found on trucks is necessary for properly applying charging systems. Generator mountings must be substantial and stable, to prevent vibration while providing accessibility and belt tension. The cranking system consists of a motor, battery, control switches and wiring, as well as drives for transferring armature rotation through a pinion to the engine ring gear. Gasoline engines for small and medium trucks require ignition systems consisting of a battery-charging system, a distributor, a coil or pulse transformer, resistance (partly external) a secondary system of cables and insulation for high voltages, and spark plugs. Future development envisioned include expanded use of electronics for ignition systems. Electronics will allow more accurate control of basic engine timing, of temperatures at various points (ambient, engine coolant, exhaust gas, etc.), of exhaust gas composition, of throttle position and rate and direction of throttle movement, of fuel and air flow rates, and of rate and direction of engine speed changes. Control of other parameters, such as engine speed, drivability, performance, and

demonstrated. More extensive engine mapping is essential for use in computer controls. Federal standards for lighting (enforced by self-certification) emphasize photometric requirements and are often based on SAE standards and recommended practices. Tungsten filaments and chromaticity coordinates are discussed. Vehicle instrumentation may be mechanical, electromagnetic (connected to the sensor via a wire conductor) or thermal (bimetallic indicators). Problem areas include transient voltages, electromagnetic interference, temperature, system voltage operating range, and vibration.

by Raymond E. Heller
International Harvester Co., Truck Div., Engineering Center,
Fort Wayne, Ind.
Rept. No. SP413; SAE-770180; 1977; 38p 61refs
The 23rd L. Ray Buckendale Lecture.
Availability: SAE

HS-020 703

TRANSPORTATION ENERGY CONSERVATION. A PROGRAM PLAN OF POLICY-ORIENTED RESEARCH

Transportation's role in energy conservation, the role of the Office of Transportation Research (OTR), and OTR's proposed research program, totalling 31 projects in six research areas for three fiscal years are presented. These areas are: automobile fuel economy; improving efficiency of automobile use; urban transportation; intercity passenger travel; intercity freight traffic; and transportation systems (cross-modal, econometric issues). Project descriptions include estimated cost, suggested scheduling, priority designation, interrelationships with other projects and programs, and detailed task descriptions.

by Willard E. Fraize; Michael Lenard; John Leib
Rept. No. MTR-6843; PB-240 734; 1975; 64p 11refs
Availability: NTIS

HS-020 704

PUBLIC HEARING ON OCCUPANT CRASH PROTECTION. ALTERNATIVES FOR PASSENGER CARS

The need for increased crash protection in new cars could be filled by installation of the most efficient passive restraint system, the air bag. Technical questions about passive frontal crash protection have been raised and settled, efficacy of the air bag has been demonstrated both in tests and in real-world circumstances, and alleged adverse byproducts of the system shown to be either nonexistent or removable. Air bag-protected occupants in severe frontal crashes experience greater reductions in fatal and serious injury (70%) than occupants of such crashes wearing lap-shoulder belts (55%) when both are compared to unrestrained occupants. Smaller, lighter cars cannot provide occupant protection in any kind of crash as well as larger cars, and therefore need the most effective, modern restraint systems available. In countries where the wearing of seat belts is mandatory, reductions in deaths and injuries have been less than expected, particularly as belt use in the 5-19

year-old group did not increase. Consumer interest is active in increased crash protection requiring no action on their part.

by William Haddon, Jr.
Insurance Inst. for Hwy. Safety
1977; 22p 5refs
Statement at public hearing before Secretary of Transportation.
Availability: Corporate author

HS-020 705

AUTOMOBILE SEATBELT USE IN SELECTED COUNTRIES, STATES AND PROVINCES WITH AND WITHOUT LAWS REQUIRING BELT USE

Belt use in automobiles was observed in 19 cities in five countries. In jurisdictions with belt use laws, belt use ranged from a high of 83% in Sydney, Australia, to a low of less than 1% at expressway exits in Japan. Prior to the belt law in Ontario and Quebec, Canada, and in the U.S. without a belt law, belt use ranged from a high of 33% in Los Angeles to a low of 4% in Windsor, Ont. Persons less than 20 years of age were using belts less often than adults and many people were wearing belts too loosely to be effective in crashes. The 10% to 20% reductions in deaths in countries with belt laws are not as high as would be expected from the known effects of belts, apparently because of the lower usage by those disproportionately involved in severe crashes and because belts are worn improperly.

by Leon S. Robertson
Insurance Inst. for Hwy. Safety
1977; 15p 7refs
Availability: Corporate author

HS-020 706

ELECTRIC VEHICLES 1890 - 1966. A BIBLIOGRAPHY

A companion volume to the earlier bibliography covering 1967 through 1976, this compilation of electric vehicle literature covers 1890 to 1966. Coverage includes automobiles, buses, cabs, and trucks, with equipment and various usage of such vehicles. Batteries and charging stations are included only when directly applicable to electric vehicles. Citations are arranged alphabetically by author or title, or when no author is listed, under publication year. Fifty-six books and pamphlets are listed. The fact that of the 1,528 citations, 905 or 60% appeared between 1890 and 1928 indicates the lack of progress in electric vehicle research. Except for the development of better batteries and experimental electrical propulsion systems, little seems to have changed other than body design of the vehicles.

by Delores E. Maximena, comp.; Emily R. Mobley, ed.
General Motors Res. Labs., Library - SASI, Warren, Mich.
48090
Rept. No. GMR-2425; SASI-77-521; 1977; 144p
Availability: Corporate author

HS-020 707

MAKERS IN LAND USE AND TRANSPORTATION PLANNING. FINAL REPORT

With the aim of improving communication among researchers, professionals and policymakers, and promoting understanding between elected officials and other decisionmakers and the research community, a two-day workshop was held. Using the topic of land use and transportation as a backdrop, the workshop was structured about two case studies: the I-66/METRO corridor in Northern Va. and the Mt. Hood Freeway in Portland, Oreg. Decisionmakers, planning professionals, and representatives from the land use/transportation research body met and discussed the issues, decision process, and role of communication between all three representative groups within the context of the case studies. Recommendations are presented for improving the professionals' utilization of research in the decisionmaking process as well as for redirecting research so that it is more responsive and useful to professionals and elected officials dealing with land use and transportation problems. Among these are: clarify the presentation of information, avoiding professional jargon; structure the planning process to introduce concepts and receive feedback on them on a continuous basis, not at the end of a plan-making effort; anticipate the concerns of various interest groups; seek to cross organizational lines in order to facilitate agreement on issues, changing roles occasionally to provide alternative viewpoints; encourage academics to participate in policy research; and move away from a large-scale comprehensive plan-making approach to short-range simplified processes and simpler methodologies. A new framework for evaluation of transportation planning decisions is needed, rather than an extension of the existing one at the margins.

by Douglas B. Lee, Jr.
Contract DOT-OS-60113
Rept. No. DOT-TPI-77-10-12; 1977; 92p
Availability: NTIS

HS-020 708

TEMPERATURE EFFECTS ON ROLLING RESISTANCE OF PNEUMATIC TIRES. INTERIM REPORT

A method of estimating the rolling resistance of pneumatic tires at temperature equilibrium state based on conditions at the start of rolling is proposed. The method employs an idealized, uniform source, one-dimensional heat flow model for the tire carcass and tread. Using known hysteretic loss properties and heat transfer coefficients of tire material, numerical computations were made of five tires of different constructions and the results compared with those obtained from experimental sources. The calculations form a theoretical basis for the interpretation of experimental data, and could reduce the number of full run tests necessary for tires known to have similar material characteristics.

by S. K. Clark; Ming Loo
University of Michigan Regents, Ann Arbor, Mich.
Contract DOT-OS-50113

HS-020 709

CERVICAL INJURIES: FREQUENCY, ETIOLOGY, AND SEVERITY

As a review of a portion of the literature on the subject of cervical spine injury, a table was compiled from 24 of the 100 papers and other publications which were studied. The findings and opinions of researchers relative to frequency, etiology, and severity of various types of injuries are summarized. It is estimated that approximately 17% of auto-cervical cervical injuries are fatal. Mortality in cases involving cervical cord injury is over 60%. Vertebral fracture is the most common cervical injury. Damage to intervertebral discs is rare, and muscle damage in the cervical region seldom serious. Neurological effects other than cord lesion are seen in about 50% of patients with cervical injuries. Injuries to the head, neck, far more often than to other parts of the body, include mental disturbances, even in mentally healthy individuals.

by Bruce M. Bowman
University of Michigan, Hwy. Safety Res. Inst., Huron Pkwy. and Baxter Rd., Ann Arbor, Mich. 20014
Grant SR01-AM-16869
Rept. No. UM-HSRI-BI-75-8; 1975; 24p 24refs
Availability: Reference copy only

HS-020 710

ENGINES FOR TOMORROW'S PASSENGER CARS

The technical potential of today's spark ignition gasoline engine is compared to that of the various alternate power plants for passenger cars, with special reference to the dual goals of emission control and improved fuel economy. Of the major types of engines considered, the Wankel and the steam engine are eliminated as not having the long-range potential to compete. In the category of near-term technology are the spark-ignition engine, the stratified charge, and the diesel engine. These require the minimum risk for a manufacturer and the total industry. Advanced heat engines, the gas turbine and Stirling, call for more technical innovation and a larger amount of capital risk; they have more promise of meeting the conflicting goals of fuel economy and emissions control but are less developed. Electric cars are limited by battery technology, restricted range of operation, and the eventual necessity of a distribution network. Continued improvement of the spark-ignition engine is predicted, with the diesel engine (either prechamber or the open-chamber) used increasingly, and eventual development by the end of the next decade of the turbine and Stirling engines.

by J. D. Withrow, Jr.; J. P. Franceschini
Chrysler Corp.
Rept. No. SAE-760610; 1976; 11p
Presented at West Coast Meeting, San Francisco, 9-12 Aug 1976.
Availability: SAE

originally outside the subject's car enters the space occupied by the wearer's head. Side impacts with other cars and fixed roadside objects present the main problem, even to seatbelt wearers, by producing impact of the head with invading objects or with unyielding parts of the subject's car. A fatality in such crashes is nearly always at the seating position immediately at the point of impact; death usually involves head injury. Utility poles were the roadside objects most often involved in the death of seatbelt wearers. In car-to-car side impacts which, like pole impacts, often arose from loss of control by the driver of the side-impacted car, head impact with the intruding door appeared to be a relatively frequent mechanism of fatal injury. There is a need for side door reinforcement, and especially for additional head protection, by padding and/or by helmet, and by designing structural members to yield progressively over several inches of penetration, if and when they impact the head.

by David C. Herbert; James M. Wyllie; Christopher W. Corben
Traffic Accident Res. Unit, Dept. of Motor Transport, P.O.
Box 28, Sydney, N.S.W., Australia
Rept. No. TARU-5/75; 1975; 84p 33refs
Availability: Corporate author

HS-020 712

OCCUPANT HEAD SPACE IN PASSENGER CARS

In-depth investigations of car crashes have shown that head impact with car interior walls is a chief cause of death of lap/sash seatbelt wearers. The headspace requirements of a lap/sash seat belted car occupant were determined and compared with the head space availability of some modern cars. Crash simulations were employed to map the head space required by a 50th percentile Ogle-MIRA M50/71 dummy with a stacked balljoint neck. Its kinematics were validated by head excursion data extracted from the results of tests on human volunteers reported in the literature. Three 1975 model cars were tested for head space availability and found inadequate. Head impact countermeasures were investigated. Recommendations include increasing the interior space, which is subject to limitations, providing protection by dealthalizing potential impact sites with yielding structure and padding wherever possible, and the use of a simple safety helmet (unlikely to be accepted by potential users).

by David C. Herbert; John D. Stott; Christopher W. Corben; Derrick Cutting; Neil Gillies
Traffic Accident Res. Unit, Dept. of Motor Transport, P.O.
Box 28, Sydney, N.S.W., Australia
Rept. No. TARU-1/76; 1976; 69p 21refs
Availability: Corporate author

HS-020 713

IN-DEPTH ANALYSIS OF FATALITIES TO WEARERS OF SEAT BELTS

Detailed studies were made of vehicles, crash locations, post-mortem reports and police reports following deaths of 136 persons who wore seatbelts during crashes. Most accidents were found to have occurred on fast roads, at or near roadway curves, involving collisions with objects such as poles and trees or collisions with a vehicle traveling in the opposite direction. In many crashes there was extensive distortion of the vehicle occupant compartment with broken pillars, seats,

The decreased seatbelt wearers most often died from injuries spread widely over their bodies. Death followed for others from blows confined to a small area of the body, usually the head, face, and neck region. With one exception, those who died only from forces applied through seatbelts were aged 58 years or more. Summaries of each of the 126 cases are presented. Moderate alterations to vehicles and seatbelts could possibly save as many as 40% of these deaths. Other deaths indicate a need to reduce the probability of vehicles encountering other vehicles traveling in the opposite direction on fast roads or encountering strong and rigid poles, trees and other fixed objects.

by B. A. Vazey; B. W. Holt
Traffic Accident Res. Unit, Dept. of Motor Transport, P.O.
Box 28, Sydney, N.S.W., Australia
Rept. No. TARU-2/76; 1976; 122p 22refs
Availability: Corporate author

HS-020 714

CRASH PERFORMANCE OF EMERGENCY LOCKING RETRACTOR SEAT BELTS

The crash performance of emergency locking retractor (inertia reel) seatbelts was examined by in-depth field investigations and by laboratory simulations. It was found that inclusion of the retractor increases body excursions for the wearer of a lap/seatbelt. The increase is not excessive and in general, crash performance was found to be satisfactory. Appendix A describes the dynamic test for seatbelts and how results can be affected by dummy characteristics. Appendix B presents a discussion of locking test rigs, the results of locking tests for some typical retractors and of further tests for which a flexible but nonstretching light steel cable had been substituted for the webbing.

by J. D. Stott; R. Garth; D. C. Herbert
Traffic Accident Res. Unit, Dept. of Motor Transport, P.O.
Box 28, Sydney, N.S.W., Australia
Rept. No. TARU-5/76; 1976; 66p 19refs
Availability: Corporate author

HS-020 715

CHILD RESTRAINT SIZE

A literature survey is made of Australian, British, and American sources of information for use in the development and evaluation of child safety restraints. A suitable characteristic which may be used to define accurately a restraint size is the child's mass. Dimensions are provided for relevant body lengths, such that 98% of children of given mass will be comfortably restrained. A table of normal body block dimensions is followed by a series of graphs providing data on the relationship between age, mass, size, and degree of activity of the child. In order to have the means of testing the size of a restraint, designs are proposed for four body blocks of mass 9, 14, 19, and 38 kg respectively.

by David C. Herbert; Andrei Lozzi
Traffic Accident Res. Unit, Dept. of Motor Transport, P.O.
Box 28, Sydney, N.S.W., Australia
Rept. No. TARU-6/76; 1976; 25p 11refs
Availability: Corporate author

HS-020 716

ANATOMICAL FACTORS IN LAP/SASH SEATBELT WEARING

The compulsory use of lap/sash seatbelts in Australia has improved crash protection of car occupants but belts do not always provide absolute protection and, although they assist in prevention of severe injury to head and thorax, they can produce other injuries in some crashes. Anatomical aspects of lap strap fit are reported; radiographic techniques were employed to determine the relative dispositions of the bony pelvic structure and of the seatbelt. Examinations of surface anatomy were used to demonstrate the effects of changes in seatbelt geometry. The basis of specification of seatbelt geometry should ensure that the lap strap always locates below the range of anterior superior iliac spine locations for the nominated range of wearers, and that it is steeply inclined when viewed from the side. Attachment of the lap strap to the seat rather than to the car's floor would be an improvement for most wearers.

by B. W. Holt; J. D. Stott
Traffic Accident Res. Unit, Dept. of Motor Transport, P.O.
Box 28, Sydney N.S.W., Australia
Rept. No. TARU-7/76; 1976; 47p 30refs
Availability: Corporate author

HS-020 717

AN ANALOG HEAT RELEASE COMPUTER FOR ENGINE COMBUSTION EVALUATION

An inexpensive, easy to use analog heat release computer receives analog cylinder pressure information from a fast response pressure transducer along with cylinder volume inputs from a signal generator attached to the engine crankshaft, performs analog computations upon these inputs, and produces an analog signal proportional to instantaneous heat release rate, cumulative heat release, and other parameters. The computer is described and examples provided of engine data obtained with the computer. This analog device is not designed to provide highly precise absolute values of heat release and related functions, but rather real-time relative values of these functions to help provide immediate insight into combustion phenomena. Compared with digital analysis of pressure data, it has the disadvantage of less precision due to the use of a constant specific heat ratio, as well as to the basic nature of an analog system. Its advantages are a very low initial cost, ease of use even for relatively inexperienced operators, real-time presentation of data, and ready analysis and correlation with engine combustion phenomena.

by R. A. McFarland; C. D. Wood
Rept. No. SAE-760553; 1976; 8p
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10 Jun 1976.
Availability: SAE

HS-020 718

DIESEL EXHAUST ODOR

Diesel exhaust odor, related to build and setting of the engine.

certainly. Two odors were presented in each test, one from reference engine and one from an engine with variable characteristics. Observers were asked to score the difference between the two odors. This technique reduced the effect of random variations in their sensitivity. The exhaust was passed through a coarse wire-wool filter before presentation to the observers. Thus the results apply to virtually soot-free exhaust. Odor decreased as load increased, but increased as speed increased. A noble-metal catalyst removed a substantial amount of odor, but the remaining variables had a far smaller effect.

by S. Lesley; C. C. J. French
Rept. No. SAE-760554; 1976; 27p 12refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10 Jun 1976.
Availability: SAE

HS-020 719

COMPUTER SIMULATION OF EMISSION INSPECTION PROCEDURES-ASSESSMENT OF EFFECTIVENESS

An approach to modeling the emission benefits of an inspection/maintenance (I/M) program for motor vehicles considers the following variables related to emission benefits derived from an I/M program: the level of the standard under which the vehicles were certified and their emission levels at the time of inspection, the vehicle deterioration rate characteristic of both the applied emission control technology and consumer maintenance practices, specifics of the particular I/M program (short test selected along with short test standards), and the quality of repairs made by the service industry. The model outputs the I/M benefit, (percent and tons) for hydrocarbon (HC) and carbon monoxide (CO), HC and CO failure rates, HC and CO emission error rates, and HC and CO emission error rates as a function of the number of inspection cycles to which the vehicle population has been subjected. Since the model operates with real emission input data on in-use vehicle populations, it makes no assumptions about the shape of emission distributions. The model was applied to the I/M program design currently in effect in Chicago. Average deterioration rate estimates were used. The model predicts 14% to 26% HC improvements for the first year of a mandatory enforced program with benefits increasing to 35% to 56% for a stabilized (10-year-old) program. CO benefits are 17% to 22% and 50% to 66%, respectively. The range of potential benefit in each case reflects the uncertainty associated with the quality of repairs which can be expected from the service industry. Based on the computer runs analyzed to date, the following general conclusions can be made: I/M programs expected to change the deterioration rates of vehicles in addition to providing an emission reduction with program initiation (even with I/M program average lifetime vehicle deterioration not zero); I/M effectiveness, expressed in percent, greater for 1975 model-year vehicles than for pre-1975 model-year vehicles; widely variable failure rates from year to year for a fixed short test emission standard; with a doubling of the vehicle deterioration rate nowhere near doubling of the expected I/M effectiveness program; reasonably constant difference in I/M effectiveness (as a percentage of the emissions without I/M) as a function of age resulting from a difference in initial failure rate: with

by Marcia E. Williams
Environmental Protection Agency, Washington, D.C.
Rept. No. SAE-760555; 1976; 11p 13refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10
Jun 1976.
Availability: SAE

HS-020 720

VEHICLE INSPECTION AND MAINTENANCE - THE CALIFORNIA PROGRAM

As a pilot study to detect gross emitters of hydrocarbons (HC), oxides of nitrogen (NOx), and carbon monoxide (CO), two programs are being tested in Riverside, Calif., the South Coast Air Basin of the state; they are in preparation for a 1978 mandatory vehicle inspection and maintenance (I/M) plan. A surveillance program was conducted to evaluate the Riverside loaded-mode inspection regime and an alternate idle inspection regime. Emissions and fuel economy tests indicated that there was no significant difference between the two regimes. Each regime resulted in immediate reductions on repaired vehicles of 35% to 40% in HC emissions and 30% to 35% in CO emissions, with no significant change in NOx emissions. There was a small (1%-4%) improvement in fuel economy, and the average repair cost was \$20-\$25. The more sophisticated diagnostic and repair procedures associated with the loaded-mode inspection regime did not result in improved performance of repairs when compared to the simpler and less expensive idle inspection regime. However, with average inspection costs of about \$5 per car for the loaded regime and \$4 per car for the idle regime, both approaches provided cost/effective reductions in HC and CO emissions. Other studies indicate that similar reductions are possible on catalyst-equipped vehicles and that the loaded-mode inspection program has the potential to provide significant reductions in NOx emissions on late-model vehicles. Depending on the abilities of the service industry, there may be little justification for the extra cost of a loaded-mode inspection program since an idle inspection can do nearly as good a job in detecting gross emitters; and the additional diagnostic information provided by the loaded-mode inspection seems only to confuse the service industry. In addition, since mechanics can repeat the idle tests themselves, they can better judge the repairs they made on idle malfunctions. This is not true of loaded-mode malfunctions. To improve program cost/effectiveness, the inspection standards should be set to fail at least 35% of the tested vehicles. So long as the failure rate remains below about 50%, both inspection regimes are equally capable of detecting gross emitters. It should be noted that the average emissions from vehicles which failed their inspection were approximately the same for both regimes. Additional training, especially with respect to program objectives and operational details, and greatly improved equipment maintenance are needed in the service industry to properly support any mandatory vehicle I/M program. Less additional training would be needed to implement an idle regime than a loaded-mode regime.

by G. Rubenstein; R. Ingels; R. Weis; A. Wong
California Air Resources Board
Rept. No. SAE-760557; 1976; 19p 5refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10
Jun 1976.
Availability: SAE

SCANNING ELECTRON MICROSCOPE STUDIES OF COPPER-LEAD BEARING CORROSION

The suitability of scanning electron microscopy (SEM) techniques was evaluated to determine the modes of CLR I-38 connecting rod bearing corrosion: whether the copper or lead portion of a bearing was preferentially attacked during an I-38 Test (a method for studying the oxidation and copper-lead corrosion tendencies of crankcase lubricants), and which causes of corrosion were related to lubricant and fuel composition. The initial corrosive attack on these surfaces is preferentially upon lead; subsequent attack is upon lead and/or copper. Although ethylene dibromide and ethylene dichloride fuel scavengers contribute to corrosion, the presence of halogen on after-test bearing surfaces is not necessarily associated with high bearing weight loss. The effect of ashless dispersants, alkaline detergents, and zinc dithiophosphates on bearing corrosion was also investigated. No relationship was found between additive performance and the generation of additive-derived films on bearing surfaces.

by D. G. Weetman; K. L. Kreuz; W. W. Hellmuth; H. C. Becker
Texaco Res. Center
Rept. No. SAE-760559; 1976; 8p 10refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10
Jun 1976.
Availability: SAE

HS-020 723

SYNTHETIC AUTOMOTIVE ENGINE OILS FROM A CONSULTANT'S EXPERIENCE

Complete performance results of a 100,000-mile field test with a diester synthetic oil (Oil F) run for five years under "no drain" conditions in a Lincoln Continental are reviewed. Oil F demonstrated excellent antiwear protection and maintained a high level of engine cleanliness for the test period. Basic test results show the following: total sludge rating, 44.6 (average of 8.93 out of possible 10 (clean)), total varnish rating 43.6 (8.72), average transverse cylinder bore wear of 16 ten thousands of an inch, and low value train wear and good condition. These results verified Triple Sequence V-B Test predictions for clean, low-wear service under extended "no drain" conditions. Because of the test results, this oil is considered a lifetime engine oil. Since large fleets and engine manufacturers have become interested in synthetic engine oils, a series of engine tests for synthetic oils designed to establish proven pre-test performance is proposed. Two additional candidate synthetic oils under testing are also described. Use of four different potential lifetime engine oils currently being utilized in four different automobiles was shown to give better engine performance and also to reduce engine octane requirements. The use of the Double Sequence III-C Test is shown to be mandatory in ensuring proper additive treatment and resulting viscosity control for oils in lifetime "no drain" service. Correlation plots of Double Sequence V-B or V-C Test results are shown to have good field service correlation with respect to sludge and piston varnish. Actual engine varnish in field testing is shown to be more severe than predicted by the Double V-C Test with vehicles run on petroleum oils, and less severe than predicted with synthetic lifetime engine oils. Double V-B or V-C Tests do an admirable job of forecasting field results because they are able to pick out the distinguishing base-oil characteristics. Synthetic oils appear inherently to be solvents

for unburned fuel varnishes, lacquers, and resins, and have possible solvency action for ethylene glycol. Synthetic lifetime engine oils, at low temperatures, should require about 40% to 50% of the energy to start as compared to petroleum-base oils of comparable 210° F viscosity; and warm-up time with synthetic oils is about 65% to 75% less than with petroleum-base oils. At the present time only depth-type oil filters should be used with synthetic lifetime oils with change periods on a 15,000-mile or one-year basis, whichever comes first.

by R. I. Potter
Ray Potter and Associates
Rept. No. SAE-760561; 1976; 18p 15refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10 Jun 1976.
Availability: SAE

HS-020 724

THE EFFECTS OF PHOSPHORUS-CONTAINING ENGINE OIL ADDITIVES ON EXHAUST OXIDATION CATALYST DEGRADATION

Catalyst deterioration caused by phosphorus-containing engine oil additives is investigated using a variety of engine oil blends in a steady-state engine dynamometer test. Reductions in hydrocarbon and carbon monoxide conversion in the 200-hour test are related to two parameters: quantity of phosphorus in oil added to the engine, and amount of phosphorus on the catalyst at the end of the test. Results show that catalyst conversion efficiency decreases nonlinearly with the amount of oil-derived phosphorus added to the engine, but linearly with the amount of oil-derived phosphorus found on the catalyst. A higher percentage of phosphorus added to the engine is found on the catalyst with oils containing tricresylphosphate (TCP) than with oils containing zinc dialkylthiophosphate (ZDP). For a fixed amount of phosphorus on the catalyst, oils containing ZDP are more harmful to catalyst performance than oils containing TCP. For most oils containing ZDP, phosphorus is observed to accumulate in sump oil during engine operation. Consequently, less phosphorus than that added to the engine is responsible for the decrease in catalyst conversion efficiencies observed with oils being studied. Appendices include justification for test procedure, data on phosphorus accumulation in engine sump oil, and conversion efficiency data.

by F. Caracciolo; J. A. Spearot
General Motors Corp., Res. Labs.
Rept. No. SAE-760562; 1976; 16p 11refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10 Jun 1976.
Availability: SAE

HS-020 725

CONCENTRATIONS OF NITROGEN OXIDES IN CRANKCASE GASES

Concentrations of oxides of nitrogen (NOx) including nitrogen dioxide (NO2) are measured in crankcase gas of a multicylinder engine operated at a variety of steady-state conditions. NOx and NO2 crankcase concentrations follow like trends with changes in engine operating variables as do NOx and NO2 concentrations in exhaust gas. Increasing intake manifold pressure, spark advance, and compression ratio

percentage exhaust gas recirculation decreases NOx and NO2 concentrations. Changing air-fuel ratio (A/F) from rich to lean first increases and then decreases crankcase NOx and NO2 concentrations. Maximum NOx and NO2 concentrations occur at an A/F of about 16. Engine speed affects NOx and NO2 concentrations slightly and inconsistently. Measured NOx and NO2 concentrations in crankcase gases are in the range 8.7 to 376 and 0.3 to 125 ppm, respectively. Crankcase NOx and NO2 concentrations cannot be predicted from those measured in the exhaust gases because the sources of NOx and NO2 are not identical for both crankcase and exhaust gases. Quench gases in the combustion chambers appear to be a significant source of crankcase NOx and probably a primary source of crankcase NO2. Some NO2 is also formed in the crankcase itself from oxidation of NO.

by James A. Spearot; Nicholas E. Gallopoulos
General Motors Corp., Res. Labs.
Rept. No. SAE-760563; 1976; 19p 20refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10 Jun 1976.
Availability: SAE

HS-020 726

THE VAPIPE - A PRACTICAL SYSTEM FOR PRODUCING HOMOGENEOUS GASOLINE-AIR MIXTURES

The Vapipe is a device that can reduce car exhaust emissions and improve fuel economy by better mixing of the charge entering the engine, achieved by vaporizing gasoline in the intake system. Heat is conveyed from the exhaust system by a heat pipe which can accommodate a gross mismatch between heat available from engine exhaust and heat needed to vaporize the fuel under transient conditions of engine operation. On the Vapipe system rejects surplus heat from the exhaust to the cooling system of the car. Another Vapipe system varies boiler efficiency to maintain correct flow of heat to the fuel vaporizer. Prototype Vapipes have been constructed and tested on test-bed engines under road conditions and on chassis dynamometers. The Vapipe provides good mixture distribution and allows the engine to run smoothly at weak mixtures thus permitting improvements in fuel economy and reduction in exhaust emissions. More substantial benefits in practical installations could be obtained if carburetors or other fuel-metering devices were developed to take maximum advantage of homogeneous mixtures. Significant improvements in engine warm-up time, drivability, and flexibility of operation are achieved but power output is somewhat reduced. Progress is noted in Vapipe design regarding simplification and unit compactness.

by G. A. Harrow; W. D. Mills; A. Thomas; I. C. Finlay
Shell Res. Ltd., Thornton Res. Center, United Kingdom;
National Engineering Lab., Scotland
Rept. No. SAE-760564; 1976; 18p 4refs
Presented at Fuels and Lubricants Meeting, St. Louis 7-10 Jun 1976.
Availability: SAE

HS-020 726

THE ECONOMICS OF BETTER FUEL ECONOMY FOR OWNER-OPERATORS

By careful driving and slight modification of vehicles, the owner-operator can cut down on his fuel cost without cutting down on the quality of service. Some of the simpler methods of cutting fuel consumption are: reduce speed; turn off the engine instead of letting it idle at lunch and rest stops; install a new high torque engine combined with a transmission reduction from ten speed to five or six; correctly use aerodynamic devices; use radial tires; install a fan clutch; maintain high tire pressure; keep all moving parts well lubricated; use tag and pusher axles rather than twin screw axles, when they are not needed; lower vehicle tare weight; use interior post, smooth-skin trailers rather than exterior post trailers; use horizontal posts rather than vertical ones; use round-nose trailers rather than square-nose; and plan each trip more judiciously. Reasonably sophisticated cost-benefit financial analyses can be conducted in a very simple manner to determine what changes should be made on vehicles and in driving habits. Owner-operators can profit most from taking advantage of any improvements available since fuel constitutes such a large part of their expenses.

by H. E. Seiff
Department of Transportation
Rept. No. SAE-760614; 1976; 10p 11refs
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

HS-020 727

HEAT PIPE EARLY FUEL EVAPORATION

Heat pipes for providing early fuel evaporation (EFE) are characterized by manifold to an EFE plate and carburetor riser incorporated into the intake manifold. A boiler heated by exhaust gas vaporizes liquid. Heat pipes can be used as a self-regulating EFE system without direct coupling of intake and exhaust manifolds, at some sacrifice in warm-up rate from that of direct exhaust heat. A 1,360 kg car equipped without emission control system composed of lean mixture carburetion, heat pipe EFE, and exhaust gas recirculation achieves emission levels of 0.7 gpm HC, 5.8 gpm CO, 1.7 gpm NOx on 1975 FTP with good cold start driveability. The primary durability problem with heat pipes is decomposition of heat transfer fluid, resulting in formation of noncondensable gases and/or scale on pipe walls and wick surfaces. Possible solutions incorporate use of water in heat pipe systems, nickel-chromium alloy, or copper heat pipes. Evaluation of heat pipe durability in the automotive environment is necessary before EFE systems can be considered for production.

by John L. Harned
General Motors Corp., Engineering Staff
Rept. No. SAE-760565; 1976; 14p 8refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10 Jun 1976.
Availability: SAE

HS-020 728

A HEAT PIPE CONTROLLED-TEMPERATURE COMBUSTOR FOR LOW NITRIC OXIDE EMISSIONS

Use of heat pipe to control nitric oxide formation in post-flame gases of a continuous-flow combustor is investigated for steady-state conditions. Analytical modeling of the heat plate predicts that emission levels of nitric oxide formed in post-flame gases will be several orders of magnitude lower than those associated with an uncontrolled case. Compatibility of a heat pipe with a high-temperature environment is demonstrated by exposing a sodium heat pipe to a propane-air flame for 1,000 hours with no measurable degradation in performance. Quantity of nitric acid formed in the flame front may be substantial in some combustors and is not amenable to reduction by the heat pipe concept used. Transient operation is an additional potential problem area for vehicular applications of the study combustor. Nomenclature used is listed and defined. Appendices present information on mixture properties, tubing blockage factor and hydrogen diffusion.

by Dean C. Hammond, Jr.; James N. Mattavi
General Motors Corp., Res. Labs.
Rept. No. SAE-760566; 1976; 19p 20refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10 Jun 1976.
Availability: SAE

HS-020 729

HYDROGEN AUTOMOTIVE FUEL: PRODUCTION AND DELIVERY

Procedures and processes for sources of hydrogen fuel are being researched as alternatives to steam-reformed natural gas. Hydrogen can be produced by electrolysis of water, or coal and water. Thermochemical, photochemical, and biochemical procedures are being researched as long-term routes to hydrogen. Feasibility studies indicate the possibility of long-distance transmission of hydrogen gas via pipeline. Local distribution of hydrogen fuel presents efficiency and safety problems which require further investigation and development. Synthetic fuels such as liquid hydrocarbons from coal or oil shale are favored alternative automotive fuels for the mid-term future, for technical and economical reasons. Liquid hydrocarbons from coal are the preferred alternative fuels for transportation and for automotive uses as long as coal is available at approximately its current price. Higher cost and lower efficiency are characteristic of hydrogen production, transport and processing at this time, compared with synthetic gas and distillate oils. As transport, processing, and particularly production routes for hydrogen are more highly developed, the cost/efficiency ratio of hydrogen use will improve.

by J. B. Pangborn; T. D. Donakowski
Institute of Gas Technology
Rept. No. SAE-760568; 1976; 12p 20refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10 Jun 1976.
Availability: SAE

HS-020 730

METAL HYDRIDE STORAGE FOR MOBILE AND STATIONARY APPLICATIONS

Metal hydride compounds provide compact storage in a form which is possibly better than cryogenic liquid hydrogen on a volume basis. Hydrides derived from rare earth, iron-titanium, and magnesium alloys have reversible formations. Heat must be provided to decompose hydride compounds and release hydrogen, while heat is liberated when compounds are formed and must be removed to allow hydriding reactions to reach completion. Iron-titanium alloy is an effective hydride storage medium in stationary applications, or where weight is not a limiting consideration. Magnesium alloy is a promising medium for mobile applications. Iron-titanium and magnesium alloys have unique pressure-temperature characteristics and reaction kinetics which must be considered in hydrogen storage system design.

by K. C. Hoffman; J. J. Reilly; F. J. Salzano; C. H. Waide; R. H. Wiswall; W. E. Winsche
Associated Universities, Inc., Brookhaven National Lab.
Rept. No. SAE-760569; 1976; 17p 22refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10 Jun 1976.
Availability: SAE

HS-020 731

RECENT PROGRESS IN THE HYDROGEN ENGINE

Current technical status of hydrogen engines is summarized, based on a 50-engine survey of recent U.S. research and demonstration activities. A comparative hydrogen/conventional-fuel orientation is maintained in assessing basic fuel property, engine power and efficiency, emissions and general operating characteristics. The hydrogen engine offers potential for significant gains in overall vehicle system energy conversion efficiency, but high production and delivery costs, distribution problems, and hydrogen storage difficulties presently limit usage. Technical approaches used in hydrogen admission, such as carburetor or gaseous fuel mixer or induction manifold part injection, obviate characteristic hydrogen engine problems. Reduction in output power at ultra-lean settings is significant. Operational problems such as induction manifold backflashing; preignition; rapid pressure rise; and rough combustion are detailed. A maximum power level reduction is experienced in hydrogen engines as opposed to gasoline engines. Hydrogen fuel generally displays lower engine emissions than conventional fuels, although NOx emissions tend to be high.

by William J. D. Escher; E. Eugene Ecklund
Escher Technology Assoc.; U.S. Energy Res. and Devel.
Administration
Rept. No. SAE-760571; 1976; 14p 14refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10 Jun 1976.
Availability: SAE

HS-020 732

HYDROGEN STORAGE IN VEHICLES - AN OPERATIONAL COMPARISON OF ALTERNATIVE PROTOTYPES

Several prototype containers for storing hydrogen include a cryogenic vessel and three metal hydride containers of similar design but different size, used in automotive service. Hydrogen release rates are controlled to match engine demand. All hydrogen storage prototypes are able to sustain a steady state flow rate sufficient for vehicle operation at normal cruise speed. In order to illustrate the principle of hydride operation, a pressure-temperature history for recharge of a small portable hydride tank is given along with several discharge curves with and without heating. High weight of hydrogen, recharge time, discharge rate, and contamination rate are research and development contingencies.

by Ronald L. Woolley; Harold M. Simons
Billings Energy Res. Corp., Provo, Utah 84061
Rept. No. SAE-760570; 1976; 11p 13refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10 Jun 1976.
Availability: SAE

HS-020 733

HYDROGEN FUEL IN THE SUBCOMPACT AUTOMOBILE

Metal hydride systems tested on vehicular prototypes using cryogenic liquid containers and iron-titanium hydride tanks show good engine performance despite problems of cryogenic systems such as hydrogen boil off rate and cost. Up to 86% increases in thermal efficiency are seen in prototype vehicles operating on hydrogen. Weight of metal hydride systems is excessive enough to block application in small or standard size automobiles, whereas buses can be operated over an effective range without exceeding gross weight limitations of the chassis. Operation of the hydrogen engine in air with a virtually pollution free exhaust is possible using combustion control techniques such as water induction for temperature control. The hydrogen-metal hydride system is superior to alternate energy schemes such as coal-generated gasoline, methanol or electricity for overall resource utilization efficiency. Safety of hydride storage designs depends on design of equipment based on flammability of hydrogen. A low cost electrolyzer for hydrogen production can be used to recharge the vehicle. However, system efficiency is greater if coal is used to generate hydrogen directly, compared to coal generation of electricity.

by Roger E. Billings
Billings Energy Res. Corp.
Rept. No. SAE-760572; 1976; 11p 19refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10 Jun 1976.
Availability: SAE

HS-020 734

ADVANCES IN HYDRAULIC OIL ADDITIVE TECHNOLOGY

superior to conventional zinc dithiophosphate technology. Ashless technology, compared with several new types of stable zinc products, offers advantages in the critical area of oxidation-thermal stability, due to its ability to overcome base stock problems. Other advantages of ashless technology are protection of copper and its alloys; wear control; and length of useful life. The CIGRE test is recommended for predicting oxidation stability in several types of hydraulic oils. The Cincinnati Milacron Heat test for thermal stability is also recommended. Hydrolytic stability is usually measured with the ASTM D-2619 test. ASTM D-1401 is the most used test of demulsibility and rust inhibition properties. The Low Velocity Friction Apparatus test is often used to identify frictional properties of hydraulic oils. The Four Ball Wear test measures antiwear properties. Ashless technology can satisfy a wide variety of requirements, offering both formulators and users the opportunity for consolidation of product lines and inventories via the multi-purpose hydraulic oil route. An appendix details SAE No. 2 Friction Machine Test for Hydraulic Oil Stability in the Presence of Copper of Its Alloys.

by Andrew G. Papay
Edwin Cooper, Inc.
Rept. No. SAE-760573; 1976; 12p 7refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10
Jun 1976.
Availability: SAE

HS-020 735

EXTENDED LIFE FOR TRANSMISSION COMPONENTS THROUGH LIMITED AIR BREATHING

Performance of mineral oil base automatic transmission fluids (ATF) in sealed transmissions is studied to measure the effect of constant supply of oxygen on transmission durability life and potential for continued indefinite use of mineral oil based ATF. Eight Ford C6 transmissions are operated for up to 89,000 miles with zero or minimal fluid make-up and with transmissions effectively sealed to prevent air breathing. Comparisons among four transmissions run on a standard ATF and four run on experimental mineral oil base ATF show more durability and stability of the experimental ATF. No significant oxidative degradation is observed with mineral oil base ATF's. Fortified mineral oil based ATF's seem more chemically stable than standard ATF's. Normal transmission system wear is probably decreased significantly with mineral oil based ATF's, evidenced by excellent post-test condition of thrust washers and bushings. Restricting oxygen availability in transmissions can extend usage of mineral oil based fluids and current component materials in forward model automatic transmissions. Development and production of sealed transmissions is suggested as an alternative to the current practice of ATF reformulation. Appendix presents process of nitrogen purging of transmission fluid.

by F. A. Christiansen; J. R. Dunn; W. D. Ross
Chevron Res. Co.; Polysar Ltd.; Ford Motor Co.
Rept. No. SAE-760574; 1976; 11p 2refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10
Jun 1976.
Availability: SAE

HS-020 736

FOAMING AND AIR ENTRAINMENT IN AUTOMATIC TRANSMISSION FLUIDS

The Ford Dynamic Aeration Test Apparatus is used to evaluate foaming, air entrainment, and air release properties of selected automatic transmission fluids (ATF). Behavior of ATF formulations varies significantly depending on properties considered and test conditions. ATF's do not exhibit consistently low (desired) or high values for all parameters evaluated, making differentiation among fluids difficult. A rating procedure for ATF's is based on arbitrarily chosen limiting values for each property considered, with particular emphasis on the total air retained by the fluid in the form of both foam and entrained air. The Ford dynamic aeration test apparatus can assess effects of operational temperatures, pressures, air humidity, and aeration rate. Results indicate that foam collapse times are not affected by an increased aeration rate. Foam values generally decrease with increased aeration rate. Increasing temperature results in increased air retained volumes and foam volumes as measured air retained volumes and foam volumes decrease with increasing pressure. Small increases in foam and air retained volumes are observed in humid air. Most comprehensive information for fluids evaluation is obtained at 93.3° C.

by L. T. Dixon; S. Korcek
Ford Motor Co., Fuels and Lubricants Dept.
Rept. No. SAE-760575; 1976; 12p 13refs
Presented at Fuels and Lubricants Meeting, St. Louis, 7-10
Jun 1976.
Availability: SAE

HS-020 737

COMPARISONS OF EXHAUST EMISSIONS AND FUEL CONSUMPTION CHARACTERISTICS - 1974 AND 1975 CALIFORNIA AUTOMOBILES

Exhaust emission and fuel consumption data for 1974 and 1975 California automobiles are generated using the EPA Federal Test Procedure. Fuel consumption data are generated by a highway cycle test and in-service vehicle fleet records from three automobile manufacturers. Reductions in 1975 automobile emissions levels are 96% for hydrocarbons; 94% for carbon monoxide; and 66% for oxides of nitrogen. Lower 1975 emissions levels are largely due to stricter state standards and wider use of catalytic converters. Comparison between published fuel consumption estimates and approved method of data calculation for the urban cycle show the approved method consistently indicating higher fuel efficiency. Comparison between the approved (FTP) method and the direct method for the urban cycle indicate that the approved method results in consumption of more fuel than the direct method. Published fuel consumption estimates versus direct method of fuel consumption calculation for the highway cycle test result in higher, lower, and no difference estimates for three different engine families. Composite consumption comparisons between published estimates, direct calculation method and in-service fleet records reveal no significant difference for all three engine families between direct method data and in-ser-

vice fleet data. A better indirect fuel measurement method is needed to evaluate fuel consumption for in-service conditions.

by Michael R. Appleby; Louis J. Bintz; Thomas A. Tappenden
Automobile Club of Southern California
Rept. No. SAE-760581; 1976; 10p 6refs
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

HS-020 738

LOS ANGELES AIR IS MUCH CLEANER

Air monitoring data and references are presented which show that Los Angeles photochemical and auto-caused air pollution, the worst in the U.S., has been improved recently due to control programs. Los Angeles pollution problems are due to unique meteorology and geography; number of cars; and volume of industry. Control programs center on enforcement of increasingly stringent emission standards on new vehicles and stationary sources, for example, 1975 vehicle emission standards, control of vapors at service stations, and 1975 standards for nitrogen oxide emissions from power plants. Air pollutants are continuously measured at air monitoring stations around the Los Angeles Basin. Photochemical air pollution, indicated by ozone readings, has decreased at most air monitoring stations since 1970, with a 26% reduction at one location. Nitrogen dioxide exceeds county standards for 125 days in 1971, decreased to 78 days in 1975. Carbon monoxide exceeds county standards for 15 days in 1969, reduced to only 3 days in 1975. Sulfur dioxide readings register approximately 580 tons per day in 1955, down to approximately 320 tons per day in 1973. Sulfate and particulate matter levels are currently lower than they have been in the past, and visibility levels at five locations are higher in 1975 than in 1973. No evidence exists to indicate that Los Angeles photochemical air pollution levels have affected area death rates.

by Miles L. Brubacher
Rept. No. SAE-760583; 1976; 16p 32refs
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

HS-020 739

ENGINEERING OPTIONS IN THE CHOICE OF AUTOMOTIVE FUELS IN THE NEXT DECADE

Methanol is the most likely alternative fuel form due to the technical feasibility of its manufacture and utilization. Problems of methanol use involve adaptations in fuel distribution and automotive systems. Potential exists for improved energy efficiency in systems designed to use methanol. Conventional liquid fuels derived solely from coal or oil shale are unlikely within the decade. However, oil shale crude may supplement natural crude in refinery feedstocks with little effect on characteristics of finished fuels. Given current nonautomotive fuel demand patterns, the total energy consumed in refining automotive fuels would be reduced, and net product energy per crude barrel increased, by use of automotive diesel

Broadcut fuel roughly approximating a mixture of equal parts of diesel and gasoline may offer advantages via process energy savings. Increased use of distillate transportation fuels could result in process energy savings. However, increased automotive diesel demand beyond a 1:1 distillate/gasoline ratio may involve process energy penalties.

by R. W. Hurn
Energy Res. and Devel. Administration, Bartlesville Energy Res. Center, Bartlesville, Okla.
Rept. No. SAE-760584; 1976; 10p 11refs
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

HS-020 740

THE ECONOMY AND CONVENIENCE OF MECHANICAL TRANSMISSIONS

Mechanical transmissions, which do not use energy conversion mechanisms to obtain required exchange between torque and speed, require friction elements in the drive systems. A simple mechanical transmission consists of a series of gears which turn at various speeds required to give the designed output speeds and corresponding torque. Performance characteristics are a function of power and speed range of the power plant and number and placement of ratios in the transmission. Standard compound shift mechanisms require a pneumatic powered synchronizer, which will not be necessary with adoption of a smaller splitter top. Ratio diagrams of a gearing combination can be made using vertical ratio brackets. Relationship between installed transmission cost, number of ratios and nominal capacity can be displayed graphically. Mechanical transmissions have an operating speed friction loss of approximately 3 horsepower, mainly from gearing churning the lubricating oil. Cost of transmission repairs is normally low, depending on drive system set up and skill of driver. Life expectancy can not be accurately gauged, although computer techniques are being used to predict performance and economy. Factors affecting transmission life expectancy are engine; gross combination weight; geared top speed; and operating terrain. Synchronizers and automatic transmissions are convenience factors for the driver which reduce performance capabilities of the vehicle.

by E. A. Richards
Eaton Corp., Transmission Div.
Rept. No. SAE-760585; 1976; 12p
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

HS-020 741

MECHANA-POWER: A NEW APPROACH TO INFINITELY VARIABLE TRANSMISSIONS (DOMESTIC AND FOREIGN PATENTS IN PROCESS)

Mechana-Power Drive (MPD) is a new concept for a continuously variable transmission, comprised of a variable throw crank linked to a plurality of hydraulic ratchets gear coupled

speed. Cylinder efficiency is measured on test gear by slip, torque, and temperature measurements. No practical limits on torque or power are observed with the MPD transmission.

by Laird G. Gogins; Christopher P. Russell
Power-Matic Corp.
Rept. No. SAE-760586; 1976; 11p 3refs
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

HS-020 742

AIR BRAKE SYSTEM TRENDS FOR THE 80'S

Air brake systems of the 1980's are projected to improve safety performance, maintenance, vehicle efficiency, noise reduction, and vehicle compatibility. A new compressor design which will be lighter, smaller, more durable, and quieter is expected to provide higher outputs with significantly improved efficiency, quieter operation, and minimized air contamination. A new parking brake design (possibly as improved mechanical linkage brake or a simplified air actuated mechanical locking brake) will provide performance comparable to spring brakes but with reduced complexity and improved reliability. Adaptation of air disc brakes on trucks, tractors and trailers will provide improved performance, weight savings, high durability and reduced service. Improvements are expected in antilock and valving areas via electronic design and reduced complexity, respectively. Conversion is expected in the pressure indication and warning subsystem area, with electronic controls replacing mechanical controls. Additions to the air brake system are expected in the form of diagnostics, air controlled fan clutching, and air "conditioning." The engine, electrical, and brake systems will have diagnostic monitoring. Fan clutches and desiccant type air "conditioners" should be standard equipment by the 1980's. Most vehicle systems will be electronically versus mechanically controlled by the 1980's.

by J. P. Koenig; R. D. Kreider
Bendix Heavy Vehicle Systems Group
Rept. No. SAE-760587; 1976; 11p 8refs
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

HS-020 743

FUEL ECONOMY OF LIGHT-DUTY DIESEL VEHICLES

Fuel economy and emission characteristics of two light-duty diesel-powered passenger cars weighing 3,500 and 5,500 pounds are determined and compared to those of similar 1975 model year gasoline-powered vehicles. Experiments are conducted using a 198 cubic-inch displacement (CID) diesel engine and a 247-CID diesel engine mounted on a dynamometer stand with turbocharging, combined supercharging/turbocharging, and varied engine-to-vehicle speed ratio as experimental variables. Diesel and gasoline powered vehicles have comparable performance. Diesel engines with 247 and 636-CID give 43% and 33%, respectively, better city/highway fuel economy than 250-CID and 440-CID 1975 model gasoline engines. In the 3,500 pound vehicle, emissions from diesel and gasoline en-

gine with no penalty in fuel economy during road-load cruise or normal city/highway driving cycles. Emissions are higher for the supercharged/turbocharged engine as compared to the naturally aspirated engine. Appendices present data on fuel economy and emissions during steady-state and road-load cruise. Calculation of time for 30-60 mph wide-open-throttle acceleration is explained.

by R. D. Fleming
Bartlesville Energy Res. Center
Rept. No. SAE-760592; 1976; 17p 11refs
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

HS-020 744

AN EQUIPMENT SUPPLIER'S VIEW ON REGULATIONS

Federal safety standards, particularly FMVSS 121, Air Brake Systems, impact on vehicle manufacturers, builders, and users of specialized equipment, and inspection enforcement agencies with regulations, procedures, and economic penalties. Federal enforcement policy involves definitions of responsible parties, penalties, and noncompliance correction by several Federal enforcement agencies within NHTSA. The Office of Crash Avoidance originates vehicle and equipment standards. The Office of Standards Enforcement enforces OCA standards. The Office of Defects Investigation monitors motor vehicle equipment and motor vehicles for any safety-related defects. Equipment suppliers should develop proprietary test facilities and test equipment to obtain certification of performance to recognized procedures. Compliance evaluation contracts issued by the Office of Standards Enforcement can be reviewed for information relating to test procedures prepared for specific standards. Typical equipment supplier activities in the process of product acceptance should follow established procedures for application and release timing, and dynamometer and stopping distance requirements. More orderly rulemaking practices utilizing Advance Notice of Proposed Rulemaking (ANPRM) are recommended for conservation of resources and improvement in cost/benefit ratio.

by John W. Kourik
Wagner Electric Corp.
Rept. No. SAE-760593; 1976; 12p 33refs
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

HS-020 745

AN INTEGRATED APPROACH TO MEASUREMENT OF EXHAUST AND INTAKE NOISE

Measurements are made of the internal exhaust and intake pressure waveform and the external radiated exhaust and intake noise for five basic exhaust and intake systems on a Continental F-163 engine. The standard straight pipe exhaust system with no muffler produces highest sound pressure levels at the manifold transducer. Significant changes in configuration of the intake system cause little detectable change in the

amplitude or shape of the pressure-time waveforms or the low frequency spectra analysis for the intake manifold measurements. Conclusions suggest that radiated exhaust or intake noise is not a strong function of manifold pressure amplitudes. Damping produced by exhaust systems is sometimes a significant contributor to overall noise reduction. Reflections due to impedance changes are a significant contributor to overall noise reduction. Horsepower is not strongly related to observed exhaust or intake restriction measurements. Intake manifold pressures typically show less variation for changes in intake systems than exhaust manifold pressures for changes in exhaust system. Overall radiated intake and exhaust noises show small fluctuations with changes in intake and exhaust systems. Changes in the exhaust system do not affect observed intake restriction significantly. Decreases in observed intake restriction with changes in intake system produce small increases in observed exhaust restriction.

by D. A. Olson; D. C. Flanders; L. J. Eriksson
Nelson Industries, Inc., Corporate Res. Dept.
Rept. No. SAE-760602; 1976; 12p 10refs
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

HS-020 746

INTERIOR NOISE PROBLEMS OF SMALL DIESEL-POWERED BUSES

Interior noise problems characteristic of the combination of diesel engines with typical small bus geometries are discussed, based on test of five small buses. Natural air vibration modes for small bus interior dimensions give frequencies that can be stimulated by noise and vibration at engine firing frequencies. This potential for low-frequency resonances constitutes a noise problem. Other noise problems are associated with internal front engine covers, and leaks and low transmission loss paths in the console area. Low-to-medium noise frequencies are fundamentally more difficult to treat than mid-to-high frequency noise problems. Airborne noise and vibration should be kept out of the bus interior due to inadequacies of absorption materials inside the bus. Isolation materials such as film-faced absorption materials are suggested for isolating vibrating and vibrated components such as the engine and windows. Sound barrier materials in flat sheet and formable forms are suggested for minimizing acoustical leaks and blocking airborne noise from entering the interior. Vibration damping materials in adherable sheet or liquid form are recommended for damping vibrating panels. An appendix presents data on natural frequencies for two bus cavity sizes.

by Gary L. Marlotte
H. L. Blachford, Inc.
Rept. No. SAE-760603; 1976; 12p 12refs
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

HS-020 747

OTHER ENGINES, OTHER FUELS: AN OVERVIEW

Of the potential fuel sources such as liquid and gaseous fuels from coal, the most feasible for spark-ignition engines are methanol and hydrogen. Wider use of either alternative fuel

to gasoline-powered, Otto-cycle engines due to their capacity for improved fuel economy, reduced emissions, and production feasibility. Diesel engines have presently limited use in light-duty vehicles due to lower specific power, noise, and production cost. Many diesel engines do not presently meet emissions standards. Rotary (Wankel) engines are smaller and lighter for a given power output, but have lower engine efficiency. Gas turbines, the most developed production alternative engine, are delayed in production due to high cost and efficiency problems. Rankine cycle or steam engines have internal combustion. Disadvantages include greater weight, poorer fuel economy, long start-up time, and potential freezing of working fluid compared with Otto-cycle engines. Stirling cycle engines are external combustion, use hydrogen as working fluid, and should be capable of high efficiency. Electric powered vehicles are limited by size of on-board energy storage system.

by L. S. Caretto
California State Univ. - Northridge
Rept. No. SAE-760608; 1976; 16p 63refs
Presented at West Coast Meeting, Jack Tar, San Francisco, 12 Aug 1976.
Availability: SAE

HS-020 748

HYDROGEN: PRIMARY OR SUPPLEMENTARY FUEL FOR AUTOMOTIVE ENGINES

Hydrogen, gasoline, and mixtures thereof are compared as fuels of lean burn engines and found to offer increased economy over the baseline at equal or lower NOx emission levels. Hydrogen for the mixed fuels tests is generated by partial oxidation of gasoline. Hydrogen combustion yields the highest thermal efficiency at any NOx level. Gasoline yields the second highest thermal efficiency for NOx levels greater than or approximately equal to two gm/mi. For lower NOx levels and high vehicle inertia weights, progressively more hydrogen supplementation is the second most efficient system. For vehicle inertia weights below 5,000 lbm (2,300 kg), the statutory NOx standard of 0.4 gm/mi can be met with 1.5 lb/hr (0.13 g/s) hydrogen supplementation. Lean burn engines using gasoline and hydrogen supplemented gasoline require no exhaust after-treatment for hydrocarbon and carbon monoxide control and perhaps cold-start hydrocarbon control. A slightly deteriorated gas generator may not substantially alter the system thermal efficiency or NOx emissions. Appendix presents engine descriptions and Federal driving cycle predictions.

by Joseph G. Finegold
California Inst. of Tech., Jet Propulsion Lab.
Rept. No. SAE-760609; 1976; 16p 4refs
Presented at West Coast Meeting, Jack Tar, San Francisco, 12 Aug 1976.
Availability: SAE
1976; 57p 8refs
Availability: National Aeronautics and Space Administration
Lewis Res. Center, Cleveland, Ohio 44135

HS-020 750

AN IMPROVED AUTOMOTIVE BRAKE LINING USING FIBROUS POTASSIUM TITANATE

Simultaneous fade reduction and wear improvement of a

potassium titanate to friction composites which are otherwise comprised of phenolic binder, asbestos fiber, and organic and inorganic modifiers. When part of the asbestos is replaced with an equal volume of potassium titanate fiber a significant increase in high temperature friction even at high binder contents is observed. Friction is evidently an increasing function of the potassium titanate fiber-to-asbestos ratio. A comparatively constant friction as a function of temperature at titanium-to-asbestos ratios of 1.5 is noted. Results show no pronounced change on low-temperature friction. Decreased high temperature (above 450° F) wear rate at binder contents near 24% (volume) for titanate-to-asbestos ratios of 1.0 and 1.5, and increased high-temperature wear rate at binder contents near or below 22% (volume) are evidenced. No significant change in low-temperature (below 450° F) wear, except for some wear impairment at the binder content of 18% is seen. The addition of fibrous potassium titanate to a commercial brake lining results in a significant fade reduction, a wear improvement of 46% averaged over the temperature range of 400° to 650° F, and no wear change at lower temperatures.

by Joseph A. Mansfield; Marcel L. Halberstadt; Salvatore R. Riccitiello; Seong K. Rhee
Ames Res. Center, Moffett Field, Calif. 94035
Rept. No. NASA-TN-D-8363; 1976; 16p 7refs
Availability: National Aeronautics and Space Administration, Washington, D.C. 20546 \$3.25

HS-020 751

SELECTED TRANSPORTATION TOPICS: ENERGY PRIMER

Ten abstracts were selected from recent literature regarding current and forecast energy transportation situations in the U.S. Energy statistics, supply and utilization forecasts, and evaluations of conservation alternatives. Each abstract includes as much as possible of the data and numerous tables.

Department of Transportation, Tech. Sharing Program Office, Kendall Square, Cambridge, Mass. 02142
Rept. No. DOT-TSC-OST-76-64; PB-263 077; 1975; 77p
Includes HS-020 752-HS-020 757.
Availability: NTIS

HS-020 752

ENERGY AND ENVIRONMENTAL ASPECTS OF U.S. TRANSPORTATION

Transportation uses 15% of the total U.S. energy, 53% of the petroleum resources, and 13% of the total personal expenditures, and produces 27.5% of all air pollutants. Close range problems in transportation's future include the impending energy and environmental crisis. The present fuel shortage is caused by a combination of increasing petroleum consumption, decreasing domestic production, the lack of increased capacities of refineries, and governmental delays in relaxing import quotas. Environmental Federal regulations controlling emission and safety standards, when implemented, will eliminate atmospheric pollution, but increase fuel consumption. Long term changes in transportation will have to appear in new societal trends, such as a shift to vehicles for specific uses and the phasing out of comfort devices in automobiles. Future technology for transportation will have to deal with the depletion of fossil fuels and their replacement as an energy source

are developed, the U.S. energy supply, which is already greatly dependent on imported oil, will have to be federally regulated, such as allowing domestic petroleum companies greater profits, relaxing environmental standard deadlines, and encouraging conservation. Almost 40% of transportation costs are on automobiles, the least efficient mode of transportation. Energy conservation options are to shift to a more energy-efficient mode, such as from automobiles to bus; to improve energy efficiencies, such as encourage smaller cars, reduce tire and aerodynamic drags, reduce power to comfort accessories, reduce performance requirements, develop more efficient engine and transmission systems, enforce stringent vehicle maintenance requirements, and develop energy-storage drive trains, improve usage patterns, such as lower highway speed; reduce travel demand through government taxation, increase use of communication systems, and better land use with homes and offices in closer proximity; and increase load factors, such as carpooling. In comparing the different approaches to conservation for time, means, benefits and likelihood of implementation more efficient use of the automobile with future implementation of better propulsion systems, alternate fuels, and government taxes on petroleum appears the greatest opportunity for energy conservation.

by W. E. Fraize; P. Dyson; S. W. Gouse, Jr.
Mitre Corp.
Publ: HS-020 751 (DOT-TSC-OST-76-64), Selected Transportation Topics: Energy Primer, 1975 p3-9
Rept. No. MTP-391; 1974
Condensed from the original.
Availability: In HS-020 751

HS-020 753

ENERGY REQUIREMENTS FOR PASSENGER GROUND TRANSPORTATION SYSTEMS

By calculating the energy consumed by one traveler using a variety of modes and trip types - intraurban commute, suburban-to-urban commute, and intercity trip - and comparing the energy consumption and energy efficiencies of the various modes, the following technical and institutional recommendations were made for energy conservation: to research and develop more efficient engines; to develop more efficient traffic control systems; to develop innovative and new mass transit systems; to develop alternate fuels; to develop a research program to analyze passenger attitudes toward alternate modes of transportation and introduce ideas to make them more appealing; to encourage smaller cars; to inform the public of the energy efficiencies of the different modes; to subsidize alternate modes; to investigate the restriction of autos in the central cores of cities; to research telecommunications; and to promote increased load factors.

by W. P. Gross; J. G. McGowan
University of Massachusetts, Amherst
Publ: HS-020 751 (DOT-TSC-OST-76-64), Selected Transportation Topics: Energy Primer, 1975 p10-8
Rept. No. ASME-73-ICT-24; 1973
Condensed from the original. Presented at Intersociety Conference on Transportation, Denver, 23-27 Sep 1973.
Availability: In HS-020 751

HS-020 754

ENERGY CONSUMPTION FOR TRANSPORTATION IN THE UNITED STATES

Future patterns of transportation energy consumption in the U.S. are projected based first on the current trend of growth (Future I) and then assuming a moderate but steady shift toward more energy-efficient modes (Future II). Both Future I and II projections were calculated with the same passenger-miles and freight ton-miles, and compared and charted the energy consumption for intercity freight traffic, intercity passenger traffic, and urban passenger traffic. Intercity freight traffic (pipelines, waterways, railroads, trucks and airways) uses 12% of the transportation energy budget; intercity passenger traffic (primarily automobiles, but also airplanes, buses and railroads) uses 33% of the transportation energy budget; and urban passenger traffic (dominated by automobiles) uses 29% of the transportation energy budget. A large amount of energy could be saved by shifting to more energy efficient modes, reducing the number of freight and passenger miles, readjusting Federal regulations and subsidies, and by technological improvements.

by Eric Hirst

Oak Ridge National Lab.

Publ: HS-020 751 (DOT-TSC-OST-76-64), Selected

Transportation Topics: Energy Primer, 1975 p30-8

Rept. No. ORNL-NSF-EP-15; 1972

Condensed from the original.

Availability: In HS-020 751

HS-020 755

TRANSPORTATION ENERGY CONSERVATION: OPPORTUNITIES AND POLICY ISSUES

To meet the energy shortage, besides increasing the supply of energy by developing new technologies, available energy must be used more efficiently if dependence on other nations is to be reduced, balance of payment deficits lowered, and additional time provided for development of more efficient energy conversion and pollution control. Energy use for transportation doubled over the past twenty years due to a larger volume of traffic, both passenger and freight, a decline in the energy efficiency of some modes, and a shift of traffic towards less energy efficient modes. To slow the present growth there must be a shift to energy-efficient modes, increased load factors on existing transportation systems, better vehicle economy, and less demand on transportation energy as a whole. Modifications which could be made to improve auto fuel economy are as follows: lightening of vehicle weight, use of more efficient engines, use of standard rather than automatic transmissions, less use of comfort accessories, use of radial tires, better aerodynamic shaping for vehicles, and development and use of alternative power sources. Also fuel could be conserved in other modes by deceleration of aircraft speeds and the use of lightweight construction materials by the railroad. Since a reduction of transportation energy necessitates a change in the American lifestyle, some governmental regulations will be needed to implement conservation measures. Also, government spending on transportation projects must be redirected to the most energy efficient modes. Transportation alternatives

dividuals, predictability of impact, and interaction with other national goals.

by Eric Hirst

Oak Ridge National Lab.

Publ: HS-020 751 (DOT-TSC-OST-76-64), Selected

Transportation Topics: Energy Primer, 1975 p 39-41

1973

Condensed from the original. Testimony submitted to the U.S. House of Representatives, Committee on Government Operations, Subcommittee on Conservation and Natural Resources, pursuant to hearings on the Conservation and Efficient Use of Energy.

Availability: In HS-020 751

HS-020 756

TRANSPORTATION ENERGY CONSERVATION OPTIONS (DRAFT)

Ten conservation measures - high efficiency autos; high efficiency trucks; reduced speed limits; carpooling; increased passenger aircraft load factors; increased truck load factors; urban traffic mode shift; intercity traffic mode shift; shift from autos to walking/bicycling; and freight shift from truck to rail - which inhibit growth in fuel consumption without inhibiting economic growth, offering potential savings of at least one billion gallons of fuel per year, and are capable of implementation within fifteen years, are compared for fuel savings (measured for five years, fifteen years, and ultimate savings), efficiency, costs, time span, travel time change, environmental change, and safety. For immediate savings, car pools are a promising solution, but, even though implementation time is long, improvement of motor vehicle efficiency offers the greatest potential fuel savings. In general, fuel conservation measures improve environmental quality, but require substantial investments which will prove justified on a cost-benefit basis.

by David Rubin; J. K. Pollard; Chris Horning

Department of Transportation, Transportation Systems Center

Publ: HS-020 751 (DOT-TSC-OST-76-64), "Selected

Transportation Topics: Energy Primer," 1975 p51-7

Rept. No. DOT-TSC-OST-74-2; 1973

Condensed from the original.

Availability: In HS-020 751

HS-020 757

GUIDELINES TO REDUCE ENERGY CONSUMPTION THROUGH TRANSPORTATION ACTIONS

Using ten low-cost, short-term transportation energy reduction measures (improve the flow of high-occupancy vehicles, improve total vehicular flow, increase car and van occupancy, increase transit patronage, encourage walk and bicycle modes, improve the efficiency of taxi services and goods movement, restrict traffic, develop transportation pricing measures, reduce the need to travel, and develop energy restrictions), three factors, the means by which energy consumption is reduced, environmental and socioeconomic effects, and the practicability of implementation in an urban area of a given size, are considered. In charting the energy consumption the

ent opportunities are important in determining indirect socioeconomic effects. Indirect environmental effects are analyzed by the change in ambient air quality, noise level, and congestion and by the impact of conservation measures on land use. With sample energy reduction packages the following conclusions became evident: carpooling actions are the most generally applicable and easy to implement; restrictions on gasoline sales would increase effectiveness; implementation of both carpooling and transit actions may be necessary to achieve a low reduction in energy consumption; incentive type actions are preferable to disincentives for achieving high-energy reduction; the action of improving total vehicular flow would be considered carefully before implementation, for it can be counterproductive; taxi service and goods movement improvement actions are most effective and applicable in large urban areas; local factors greatly influence the effectiveness of conservation actions; and due to overlapping, the total reduction of energy use effected by a package of actions will be less than the sum of the individual action's reductions.

by Alan M. Voorhees and Associates, Inc.

Subject: HS-020 751 (DOT-TSC-OST-76-64), Selected Transportation Topics: Energy Primer, 1975 p58-75

Condensed from the original. Report prepared for the U.S. Urban Mass Transportation Administration.
Availability: In HS-020 751

HS-020 758

IMPROVING THE HIGHWAY SYSTEM BY UPGRADING AND OPTIMIZING TRAFFIC CONTROL DEVICES

The improvement of the highway information system is assessed regarding effects on traffic control and device improvements on public roads. Human factors, safety, benefit-cost, and traffic engineering are evaluated. Findings indicate that upgrading those portions of the highway system not in compliance with the Manual on Uniform Traffic Control Devices (MUTCD) would experience significant safety benefits and improved system efficiency. Traffic control device deficiencies can lead to driver error and accidents. Roads with the lowest level of MUTCD compliance experience disproportionately high accident rates. Studies show significant safety and efficiency benefits and driver error reductions with traffic control device improvements. Optimization of the total information system could reduce accidents by 10%, allowing a benefit-cost ratio of from 10:1 to 20:1. Upgrading all traffic control devices to MUTCD standards and optimizing through positive guidance are recommended.

by H. Lunenfeld

U.S. Dept. of Transportation, Federal Hwy. Administration,
Office of Traffic Operations
Rept. No. FHWA-TO-77-1; 1977; 77p 75refs
Availability: Corporate author

HS-020 759

TRAFFIC SPEED REPORT NO. 99

A quarterly study of vehicle speeds on Indiana highways presents data for Nov and Dec 1976 based on observations of spot speeds at 14 speed monitoring stations on interstate, four-lane, and two-lane rural and interstate urban highways in Indiana. Results are obtained with a radar speed meter. Overall

average speed for all vehicles is 57.3 mph. Overall average speed for passenger cars and all trucks is 58.0 mph and 56.1 mph, respectively. Average speeds are similar for passenger cars and 0.9 mph slower for trucks than speeds found in Jul-Sep 1976 (Speed Report No. 98). Decrease in truck speeds results from a 2.0 mph decrease in average speeds of heavy trucks on the interstate system. Appendices present tabulated results of all speed observations.

by Graham S. Toft; George K. Stafford
Purdue Univ., Joint Hwy. Res. Proj., West Lafayette, Ind.
47907
Contract HPR-1(14)-1
Rept. No. JHRP-77-7; 1977; 48p
Availability: NTIS

HS-020 760

TRAFFIC SPEED REPORT NO. 98

A quarterly study of vehicle speeds on Indiana highways presents data for Jul-Sep 1976 based on observations of spot speeds at 28 speed monitoring stations on interstate, four-lane, and two-lane rural and interstate urban highways in Indiana. Results are obtained with a radar speed meter. Overall average speed for passenger cars is 58.0 mph. Overall average speed for heavy trucks is 57.1 mph. Observations at three night observation stations show night speeds to be between two and four mph less than on other stations of the same highway class during daylight hours. Speed averages are 0.7 mph and 0.3 mph lower for passenger cars and heavy trucks, respectively, than results for Jun-Sep 1975 (Speed Report No. 94). Appendices present tabulated results of all speed observations.

by Graham S. Toft; George K. Stafford
Purdue Univ., Joint Hwy. Res. Proj., West Lafayette, Ind.
47907
Contract HPR-1(14)-1
Rept. No. JHRP-77-2; 1977; 79p
Availability: NTIS

HS-020 761

ROTARY ENGINE COMBUSTION WITH HYDROGEN ADDITION

The lean operating limit of a rotary combustion engine was extended by hydrogen-enriched fuel to equivalence ratios as low as 0.49. Reductions in nitrogen oxide (NOx) and carbon monoxide (CO) emissions from baseline conditions were observed, although hydrocarbons (HC) emissions increased significantly. The effect of hydrogen-induced lean combustion on indicated thermal efficiency was found to be dependent on the change in H₂/C₈H₁₈ fraction with decreasing equivalence ratio. An increase in H₂/C₈H₁₈ fraction with decreasing equivalence ratio had little effect on indicated thermal efficiency, whereas a constant or decreasing H₂/C₈H₁₈ fraction led to a marked decrease. The brake thermal efficiency when compared at constant power increased marginally.

by J. E. Cichanowicz; R. F. Sawyer
University of California - Berkeley, Dept. of Mechanical Engineering
Grant NSF-GI-44379
Rept. No. SAE-760611; 1976; 18p 33refs
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

SYSTEMS

Torque and speed capabilities of 12 and 24 volt cranking motors for heavy duty trucks are reviewed. Advantages of 24 volt cranking are brought out: more horsepower is obtained in the same physical size of motor and battery and cranking speed is substantially higher at low temperatures, the lower cranking current of the 24 volt cranking system permits use of lighter cables, and the ground frame return system is less critical to cranking performance. The terminals and junctions are less critical, because voltage drops are lower, since cranking current is lower, and voltage drops are a lower percentage of the system voltage. The necessary dual voltage switching or transformer/rectifier systems are described. The effect of diesel crank case lubricating oil grade on cold cranking is emphasized. Importance of the new maintenance free batteries on cranking motor performance is shown. Improvements in 12 volt cranking motor performance are projected.

by Karl Groves
Sheller Globe Corp., Leece Neville Div.
Rept. No. SAE-760619; 1976; 8p 5refs
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

HS-020 764

A DESIGNER'S GUIDE FOR HEAVY DUTY TRUCK WIRING HARNESES

Practical data relate indexes of performance and indexes to cost comparisons on the lighting system for trucks, which comprises over 40% of the electrical maintenance expense. For insulating material in extremes of temperature, teflon is recommended for areas ranging from 300° F (150° C) upwards to 482° F (250° C), and for below zero applications, there are new thermoplastic rubbers. For temperatures within these boundaries, SAE J878a type SXL or crosslink polyethylene material is recommended over polyvinyl chloride and hypalon; a comparison of test results and of costs is given. Methods of protecting terminals, tests to assure mechanical strength, and environmental tests are discussed. A list is provided of things to avoid in design that would make fabrication or assembly more complicated and contribute to a more costly product. Cost comparisons of the basic construction techniques utilized in fabrication of harness assemblies are given. The need is stressed for a clear and adequate electrical schematic as an aid to the serviceman.

by Allen Coombs; William Lippert; Larry Lowden; David Michaels; Charles J. Owen; Tom Thomas Whitaker Cable Corp.
Rept. No. SAE-760620; 1976; 18p
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

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Rept. No. SAE-760620; 1976; 18p
Presented at West Coast Meeting, Jack Tar, San Francisco, 12 Aug 1976.
Availability: SAE

HS-020 765

SUGGESTED SAE STANDARD FOR IDENTIFYING AUTOMOTIVE WIRING CIRCUITS

A new simplified approach to motor vehicle electrical wiring circuit identification is needed to eliminate confusion in servicing vehicles of different manufacture. The Automotive Circuit Identification System (ACID) uses only 99 circuit numbers plus alphabetic letters, as required, and ten standard colors. These colors identify the areas or zones. Circuit number codes would be assigned to identify function, could be printed or stamped with a contrasting color on cable insulation every four inches along the entire circuit length to simplify repair or modification of a wiring harness or cable assembly. Two tables are presented describing the circuits and corresponding color identifications and numbers. This system would reduce downtime, cost of maintenance, the number of circuit number codes, and color would be easier to read, trace, repair, modify, and learn would also help prevent mis-matching of circuits, and increase the number of available mechanics to service all makes of models without additional training.

by W. S. Pape
International Harvester Co.
Rept. No. SAE-760621; 1976; 8p
Presented at West Coast Meeting, Jack Tar, San Francisco, 12 Aug 1976.
Availability: SAE

HS-020 765

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HS-020 766

BUS TRANSIT

Bus transit services can be deployed in a number of ways to make best use of the different types and sizes of buses currently available. The experience of the Santa Clara County Transit District has shown that the trend toward larger vehicles is a mistake, at least for residential neighborhoods and crowded urban areas. For these areas, consideration should be given to narrower, shorter buses complying with regulations imposed on all other vehicles on the highways and fitting into the neighborhood. Three sizes of buses are necessary to any combined deployment strategy for full-service transit. Such strategies should include both fixed route services and services which respond directly to demand. Of the county's 216-bus fleet, 138 are equipped with a gasoline engine converted to propane. This has been satisfactory in terms of power and of public acceptance. The county plans to expand its bus fleet to 516, to provide adequate service for an urbanized area of 1.2 million people and some 240 sq. mi.

by James T. Pott
County of Santa Clara, Calif., Transportation Agency
Rept. No. SAE-760623; 1976; 7p
Presented at West Coast Meeting, Jack Tar, San Francisco, 9-12 Aug 1976.
Availability: SAE

HS-020 766

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HS-020 767

A FOUNDATION FOR SYSTEMS ANTHROPOMETRY, PHASE 1. INTERIM SCIENTIFIC REPORT

Recent investigations in the dynamic properties of the human body have indicated that, contrary to earlier theory, the dynamic body does behave in a statistically predictable manner. The variation associated with the predicted results, however, must be carefully considered in a model of the open-chain link system of the human body. The present research is to lay the foundation for an anthropomorphic description of the body that will be suitable for three-dimensional, predictive models (e.g. manikins, mathematical, statistical) of dynamic behavior of the body. Three subsidiary tasks deal with the identification, location, and relationship of externally and internally "stable" landmarks; the definition of whole body and segment anatomical axes systems; and the quantitative description of body motion with probabilistic characteristics of each major joint center of mobility. Phase I has developed a measurement technique and examined some three-dimensional anthropomorphic data for analyzing variation in a sample of subjects fixed in space and time, which are set forth in a series of task reports with tables, graphs, and formulae. The role that systems anthropometry can take in handling real-world design problems that require human interface appears to be significantly larger than a comparable position for traditional anthropometry; its practicality must, however, be demonstrated.

by Herbert M. Reynolds
University of Michigan, Hwy. Safety Res. Inst., Ann Arbor, Mich. 48109
F44620-76-C-0115
Rept. No. UM-HSRI 77-7; 1977; 133p 19refs
Rept. for 1 Jun 76-30 Nov 76.
Availability: Corporate author

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HS-020 768

PERCEPTUAL THRESHOLDS IN CAR-FOLLOWING - - A COMPARISON OF RECENT MEASUREMENTS WITH EARLIER RESULTS

The results of a previously conducted field experiment to investigate the sensitivity of subjects to the sign of relative motion when following a vehicle are tabulated and compared with a number of other field, simulator, and laboratory experiments. Responses to analytical functions of relative speed divided by spacing, or spacing change divided by spacing, are used for interpretation. A relatively consistent interpretation of the data is obtained, and greater agreement between many of the experimental results than had hitherto been noted. It was concluded that when a subject moves through his environment, or views a display which simulates such movement, a negative response bias occurs; when the target moves with respect to a featureless or static background, no systematic response bias results. With a few exceptions, it is the real or apparent motion of the subject through his environment that causes the direction asymmetry in his perception of target motion.

by Leonard Evans; Richard Rothery
Publ: Transportation Science v11 n1 p60-72 (Feb 1977)
1977; 23refs
Availability: See publication

HS-020 768

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by Leonard Evans; Richard Rothery
Publ: Transportation Science v11 n1 p60-72 (Feb 1977)
1977; 23refs
Availability: See publication

HS-020 769

TIRES ROLL UP THE FUEL SAVINGS

U.S. tire makers are expending great development effort to produce new tires that will significantly help improve fuel economy in the 1978 cars. With the aim of reducing the hysteresis of the tire so that the rolling resistance of the casing can also be reduced, each component is being examined -- carcass, bead, and tread -- to see how their weight can be reduced without affecting performance. Radial tires, already preferred by the auto industry to a great extent, will probably be in almost 100% use, in redesigned form. Nylon cord and natural rubber are being tested for lower rolling resistance. Of the kinds of carcass fiber used, steel, glass, Kevlar, rayon, and nylon, steel has the best hysteresis plus economics on its side. The five major tire companies are preparing to produce small, high-pressure spare tires which carry 60 psi (419 k Pa) of air pressure, compared to 28 psi (195 k Pa) for regular tires. They will require only half as much space in the trunk and be around 20 lb. (9 kg) lighter, good for a few thousand miles and for emergency use only. To eliminate the spare altogether, the possibility of a tire with a fiberglass stabilizer or insert inside the casing, which carries the vehicle load for 50 mi at 50 mph (80 km at 80kmh), is being investigated. Another approach is a conventional tire with beefed-up sidewalls. Both these possibilities save weight and trunk space but have drawbacks. A low-pressure warning system would be needed with most run-flat tires. The new metric tire sizing system approved by the Dept. of Transportation involves a design load three or four pounds higher than the current alpha-numeric tires. It is a size-based system, compared to the former which was load-based.

by Joseph M. Callahan
Publ: Automotive Industries v156 n8 p27-31 (15 May 1977)
1977
Availability: See publication

HS-020 769

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by Joseph M. Callahan

Publ: Automotive Industries v156 n8 p27-31 (15 May 1977)

1977

Availability: See publication

HS-020 770

AUTOMOTIVE SULFATE EMISSIONS

The possibility of environmental problems arising from automotive sulfate emissions led to a four-year study by EPA. Major objectives were to obtain sulfate emission factors for a broad group of different in-use vehicles, in addition to a group of prototype vehicles, using advanced emission control methods, and to determine the effect on sulfate emissions of vehicles meeting increasingly stringent emission standards for HC, CO, and NOx. After preconditioning, six test schedules were run. The sequence was: 1975 Federal Test Procedure; Congested Freeway Driving Schedule; Congested Freeway Driving Schedule; Highway Fuel Economy Test; and two successive Congested Freeway Driving Schedules. Oxidation catalyst cars were found to have significantly higher sulfate emission rates than either current or prototype noncatalyst gasoline-fueled ones, when tested over the Congested Freeway Driving Schedule. In general, oxidation catalyst vehicles equipped with air pumps were found to have higher sulfate emission rates than those without air pumps. Sulfate emission rates were found to increase with decreasing HC, CO, and NOx emission levels, though substantial ranges were found between vehicles at each level of HC/CO/NOx control. The three-way catalyst and advanced noncatalyst gasoline-fueled vehicles tested had CFDS sulfate emission rates no higher than those typical of current noncatalyst gasoline-fueled cars. However, addition of an air injected oxidation catalyst downstream of a three-way catalyst, or addition of an oxidation catalyst to a lean burn noncatalyst system, resulted in the higher sulfate emission rates typical of air pump equipped oxidation catalyst systems. The light duty diesel vehicles tested had CFDS sulfate emission rates significantly higher than those of other noncatalyst vehicles tested, averaging 6.5 mg/km. Environmental build-ups in localized areas are unlikely to occur.

Publ: Automotive Engineering v85 n6 p26-31 (Jun 1977)

1977

Based on SAE-770166, "Automotive Sulfate Emissions -- A

Baseline Study" by Joseph H. Somers, Robert J. Garbe,

Richard D. Lawrence, and Thomas M. Baines.

Availability: See publication

HS-020 770

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Availability: See publication

HS-020 771

THE ELEMENTS IN TRANSPORTATION

With the ever-increasing complexity of modern vehicles, most of the elements in the periodic table are either necessary to, desirable for, or included in our vehicles. The major elements used by a vehicle (and in some cases consumed) are among the more familiar substances, but many others play significant roles in vehicles' refinement, measurement, laboratory study, inspection, or, through the medium of atomic power generation, manufacture. An explanation is given of the possible uses in transportation of each element, whether in the body of the vehicle, the fuel consumed, or methods of manufacture. The great interdependence of materials is stressed, and the vast options available for selection according to necessary engineering parameters.

by Albert W. Demmler, Jr.

Publ: Automotive Engineering v85 n6 p33-7 (Jun 1977)

1977

Availability: See publication

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Publ: Automotive Engineering v85 n6 p33-7 (Jun 1977)

1977

Availability: See publication

HS-020 772

A CARBURETOR FOR THREE-WAY CONVERSION

Precise control of the composition of exhaust gas entering a catalytic converter is a crucial requirement for efficient three-way catalysis. Efficiency of three-way conversion deteriorates rapidly as an air/fuel ratio strays from stoichiometric. Carter's closed-loop control is the first system to which a standard carburetor is adaptable. Comparable to Volvo's Lambda-sond system in concept, it is quite different in execution. Each system monitors exhaust gases with Bosch's oxygen sensor of the stabilized zirconia type, but Carter's sensor signal is converted to digital form, while lambda-sond electronics are essentially analog. Where lambda-sond regulates fuel via pressure changes in mechanical fuel injection, the Carter system employs auxiliary air bleeds in the main and idle circuits of an otherwise conventional carburetor. Prototype systems have been under development for several years, with evaluations by several automobile manufacturers. The system is readily adaptable to all Carter carburetors, with neither major redesign nor retooling necessary. This compatibility with existing components enhances the cost-effectiveness of hardware supporting three-way catalysis. Problems remaining are whether the mine-recovery ratio of rhodium, an element crucial to the three-way process, can be exploited economically in converter design, and whether the durability of these new components will equal that of existing systems.

Publ: Automotive Engineering v85 n6 p39-41 (Jun 1977)

1977

Based on SAE-770352, "A Feedback-Controlled Carburetion System Using Air Bleeds," by T. R. Gantzer, D. L. Hicks, and M. A. Jefferis

Availability: See publication

HS-020 772

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Availability: See publication

HS-020 773

MUFFLERS

The present state of muffler technology is discussed in terms of acoustics, engineering, three-pass silencing, design and development, and legislation. Noise from automotive engines, a blend of its fundamental firing frequency, higher harmonics of this frequency, and resonance of all its components, is commonly measured using the dBA (decibels with an "A filter") scale. Frequency peaks, resonance and white noise used to evaluate noise complexity show one consistent trend: more noise with increasing rpm. Helmholtz chambers attenuate sound by setting up carefully tuned, cancelling resonance. Resonance is created by means of an uncapped tube which opens off the path of exhaust flow, with attenuated frequency directly related to ambient velocity of sound and radius of the open-ended tube, and inversely proportional to tube lengths and volume of chamber into which it opens. Broad-band dissipators, which are less discriminating in attenuation than typical Helmholtz chambers, employ mechanical means to dissipate pressure pulses in the exhaust stream. Absorptive surfaces to deaden sound, such as asbestos interlining, are less emphasized than degree of vehicle silencing, which is generally proportional to amount of back pressure. Three-pass mufflers, which allow exhaust steam to pass through the muffler three times, depend on total exhaust-system length for determination of locations of standing wave nodes. Optimum tailpipe length is twice that of the exhaust pipe. Current muffler designs use a three-pass muffler as part of a single-exhaust system. Resonator/diffusers are sometimes fitted to the tailpipe exit, and "miracle holes" give slight modification to tube lengths and internal pressures. Catalytic converters act as high-frequency filters, minimizing noise, but possibly hasten muffler corrosion. Noise limit based on test procedure specified in SAE J986a is suggested at 86dBA, with a 2-dBA allowance. Alternative test procedures will be needed for accurate measurements at lower noise levels. Muffler fabrication has become a specialization requiring knowledge and use of a

by Dennis J. Simanaitis
Publ: Automotive Engineering v85 n6 p42-7 (Jun 1977)
1977
Availability: See publication

HS-020 773

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by Dennis J. Simanaitis
Publ: Automotive Engineering v85 n6 p42-7 (Jun 1977)
1977
Availability: See publication

HS-020 774

AN UPDATE ON SYNTHETIC OILS

A synthetic SAE 5W-20 engine oil termed Syn. 1, shows advantages over popular mineral oil products. Syn. 1, formulated on performance considerations, uses an olefin oligomer/organic ester blend as its synthesized base fluid. Olefin oligomer, compared with alkylated aromatic, shows better viscosity-temperature characteristics and is easier to inhibit against high-temperature oxidation. Syn. 1 averages 4.2% better in fuel economy over mineral oils, due to reduced fric-

tion; traction coefficient is 10% lower than a conventional SAE 20W-40 mineral oil. Syn. 1 offers oil economy equal to SAE 10W-40, 10W-50, and 15W-40 products if the engine is in good mechanical condition. One barrel of synthesized SAE 5W-20 engine lubricant such as Syn. 1 would save about 6.6 equivalent barrels of crude oil, resulting in considerable national energy savings. Syn. 1 provides exceptional SE and CC performance based on engine testing. Outstanding oxidative/thermal stability performance is seen with tests run on nine 455 CID Parkway Police fleet cars. CCMC and other European engine tests confirm that Syn. 1 exceeds proposed "common market" specification requirements. A 3.6% advantage for cold starts and 3.9% for warm starts is found for Syn. 1 compared with SAE 10W-40 SE mineral oil. Stabilized oil sump temperatures for a number of cars under road load conditions indicate that Syn. 1 runs 5-27° F cooler than higher viscosity grade reference oils. Reduction in engine oil pressure when using Syn. 1 creates no serious problems. Chassis rolls proof-of-performance tests in critical vehicles indicate that Syn. 1 has superior antiwear and cleanliness quality features. No-drain 25,000 mile field tests shown little viscosity change for Syn. 1, whereas viscosities for mineral oils change drastically.

Publ: Automotive Engineering v85 n6 p56-61 (Jun 1977)
1977
Based on SAE-770634 "An Update on Synthesized Engine Oil Technology," by J. A. C. Krulish, H. V. Lowther, and B. J. Miller.
Availability: See publication

HS-020 774

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Availability: See publication

HS-020 775

VOLKSWAGEN DEVELOPS A DIESEL

Development of a diesel engine by Volkswagen is based on the diesel's fuel, performance, emissions, and manufacturing cost advantages. Diesels satisfy current emission regulations, although their potential for meeting the proposed 0.4 g/mi NOx standard is dubious. Operating costs and service life of diesels tend to mitigate higher manufacturing costs. Direct fuel injection into the combustion chamber yields 10%-15% better maximal power and minimal fuel consumption than indirect injection designs; however higher emissions make direct injection inappropriate for passenger car development. Swirl chambers offer the best combination of engine speed capability, specific power output, and emissions behavior. Compression ratio of 23:1 is the standard, with some variance to accommodate a tight set of manufacturing tolerances. Design features a high degree of parts and manufacturing commonality with existing spark-ignition engines. Enlargement of piston heat dams and modification of water jackets are the only major engine block changes. Heater plugs are used as a cold-start aid. Intake system design is governed by high volumetric efficiency, high final compression temperature at a low engine speed, and low intake noise. Inlet-valve closing time is advanced by the engine's single overhead camshaft. The diesel fuel injection system controls power output as well as fuel supply using a Bosch distributor pump, requiring no auxiliary fuel pump. The air-intake system uses a dynamic ramp to increase volumetric efficiency at lower engine speeds. A Mable Autothermic piston is employed along with three rings and a Pirelli toothed-belt. Fleet tests determined oil change interval at 7500 miles. Driveability tests show diesel engines to be comparable with spark-ignited counterparts, with quicker acceleration and lower fuel consumption. Emissions are typically lowest under part-load conditions. Service life was determined to be roughly twice that of corresponding spark-ignition engines. Automatic transmissions and air conditioning units are currently precluded in diesel engines. Diesel engines offer greater fuel economy, reduced maintenance, and increased durability at a cost of \$170 and some loss of flexibility in service stations.

Publ: Automotive Engineering v85 n6 p62-8 (Jun 1977)
1977
Based on SAE-760591, "Advanced Automotive Power Systems, P.1: Morphological System and Systems Analysis," by P. Hofbauer and B. Wiedemann; and SAE-770113, "Advanced Automotive Power Systems, P.2: A Diesel for a Subcompact Car," by P. Hofbauer and K. Sator.
Availability: See publication

HS-020 775

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Availability: See publication

HS-020 776

FINE-PARTICLE SILICAS IN TIRE TREADS, CARCASS, AND STEEL-BELT SKIM

Fine-particle silicas, utilizing coupling agents, provide tire tread wear, traction, and heat buildup equivalent to those obtained with tread-grade carbon blacks. For passenger tread tests, N-339 black was replaced with HS-200 silica. No significant change in modulus, tensile strength, elongation, tread wear, or hardness was observed, heat buildup was generally lower, and traction on wet asphalt was significantly increased. The silane coupling agent was instrumental in maintaining a high level of physical properties. Contradictory results in other studies may be due to use of bis (triethoxysilylpropyl) tetrasulfide rather than mercaptosilane coupling agent, and failure to recognize that effective coupling of silica and rubber occurs only if the silane coupling agent is introduced with the silica in absence of materials that interfere (viz., zinc oxide). Of four compounds measured, all-silica tread has the highest, and silica and black the lowest, elastic modulus. Truck tire tread tests, substituting HS-200 silica for N-220 black, and adding mercaptosilane with silica at a level of 2% of the silica weight, showed some deficiency in cure state, which did not seem to

adversely affect tread wear. Tread wear indexes for experimental compounds were within 10% of the control compound. Heavy-service truck-tire tests, which examined cutting and chipping resistance, found it to be less extensive on tread sections containing HS-200 silica. Radial-belt skim tests showed property equivalence between certain silicas and carbon blacks. Modulus can be doubled and heat buildup reduced. Tests using HS-400 silica in belt plies of radial passenger-car tires show good heat buildup and stress-strain values. Silicas can be used in side-wall, carcass, and radial-belt compounds of tires as an alternative to conventional petroleum-derived fillers.

by M. P. Wagner
 Publ: Rubber Chemistry and Technology v50 n4 p356-63 (May-Jun 1977)
 1977; 5 refs
 Availability: See publication

HS-020 776

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by M. P. Wagner
 Publ: Rubber Chemistry and Technology v50 n4 p356-63 (May-Jun 1977)
 1977; 5 refs
 Availability: See publication

HS-020 777

VEHICLE TEST PROCEDURE DRIVING SCHEDULES. FINAL REPORT

The status of 22 vehicle test procedure driving schedules was analyzed in order to determine motor vehicle fuel economy, exhaust emissions, and component characteristics. Urban, suburban, highway/interstate, and miscellaneous categories of driving schedules are used; types of driving schedules include "nonstylized," typified by the Environmental Protection Agency's Federal Test Procedure driving schedule, and "stylized," typified by SAE's driving schedules. A major prerequisite of fuel economy test procedures is the relationship which driving cycle and driving schedule have to actual conditions and operations in normal vehicle use, measured by individual, discrete trips and aggregate travel statistics. The major difference between a stylized and nonstylized driving schedule appears to be the test procedure itself, whether it is a track or dynamometer test. The nonstylized driving schedule is difficult to perform on a track, whereas the stylized driving schedule may be utilized in either test. No single parametric evaluator appears to describe adequately the entire driving schedule, necessitating multiple descriptors of actual vehicle operation. Most driving schedules analyzed show little or no direct correlation with field data of vehicle operation; exceptions being EPA-FTP and Highway Schedules. Driving Schedules used by auto manufacturers seem to be based on engineering judgement with no supporting documentation, limiting their applicability to national scale policy decision. Correlation between future driving schedules and actual vehicle operation is recommended. Driving schedules should be based on a total trip concept and specific road type. Appendices present data on the four categories of driving schedules examines.

by Joseph C. Sturm
 Transportation Systems Center, Kendall Square, Cambridge, Mass. 02142
 Rept. No. DOT-TSC-OST-75-55; 1977; 210p 27refs
 Rept. for Apr 1974-Mar 1975.
 Availability: NTIS

HS-020 777

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Rept. for Apr 1974-Mar 1975.
Availability: NTIS

HS-020 778

HIGHWAY ENVIRONMENT SUB-COMMITTEE. FINAL REPORT

Obstacles to safe highways include the questionable effectiveness of Federal and state agency insistence upon compliance with the Federal highway safety standards and the lack of effective highway environment safety programs. Reorganization of FHWA to incorporate all safety functions under the Associate Administrator for Safety has been implemented. Institution of a full-time safety coordinator in each state to ensure implementation of Federal safety standards by the states is in progress. FHWA is in the process of assuring that the most current safety design plans and practices are incorporated into all highway projects. A National Data Center for Highway Safety Statistics has been set up in NHTSA. Department directives concerning safety standards will be mandatory in areas where an advisory role would be ineffective. Seven measures for improving safety at railroad-highway grade crossings, such as installation of automatic gates and flashing lights, are recommended. Seven recommendations for long-term success of state and community highway safety programs affecting the highway environment, including continuous safety education programs and separation of vehicle mix, are made. Future Subcommittee priorities should include pedestrian safety; the roadside hazard program; the certification acceptance program; accident response systems, and 100% funding of highway safety projects. Copies of the Subcommittee Chairman's correspondence and subcommittee minutes are included.

by John J. Gilhooly
U.S. Department of Transportation. National Hwy. Safety
Advisory Com., Highway Environment Sub-Committee
1977; 60p

Based on a two-year period, 1975-77.

Availability: Reference copy only

HS-020 779

ALCOHOL AND MOTORCYCLE FATALITIES

A series of 99 fatal motorcycle crashes from Jan 1973 through Jan 1975 in Maryland, studied using police and medical examiner records, are examined for prevalence of alcohol. For 103 motorcyclists killed (91 drivers and 12 passengers) median

cohort were negative most commonly among drivers who appeared not to be responsible for causing the crashes. Alcohol was present more often in nighttime crashes. Distribution of alcohol concentrations is roughly similar to that previously reported for drivers of cars and trucks who were killed in Maryland. Police reports mentioned alcohol in only nine instances. Causal role of alcohol is suggested by the association between presence and amount of alcohol and the degree to which motorcyclists appear to be responsible for causing crashes. In addition to alcohol, motorcycle visibility, road curvature, and helmet use appear to be relevant factors.

by Susan P. Baker; Russell S. Fisher
Publ: American Journal of Public Health v67 n3 p246-9 (Mar 1977)
1977; 17refs
Availability: See publication

HS-020 780

NEW-CAR BUMPERS FLOUT INTENT OF '72 LAWS IIHS TESTS SHOW

Testimony by the Insurance Institute for Highway Safety (IIHS) before the House Subcommittee on Consumer Protection and Finance presents results of low-speed impact tests of 1977 foreign and domestic cars with damage-resistant bumpers, for evaluation of present and prospective Federal standards to reduce damageability of cars in low speed crashes. Speaker contends that technology available for developing effective damage-preventing bumper systems is not being utilized by car manufacturers, and that costs of "minor" repairs are astronomical. DOT's present standard FMVSS 210 to prevent damage to safety-related components in low speed test crashes has had insufficient effect in reducing damageability since its inception in 1972. A DOT standard to reduce property damage in front and rear low speed crashes, mandated by Title I of the Motor Vehicle Information and Cost Savings Act of 1972, is still not in effect although it is tentatively due to be implemented in 1979 and 1980 model year. Production of bumpers to meet FMVSS 215 standards often results in heavy, expensive and crash-ineffective bumper. Film excerpts of IIHS crash tests, Volvos, and Gremlins show some improvement in ability of new cars to resist override and damage. Minor corner impacts not covered by DOT's compliance tests show current designs to be inviting needless damage. The 1977 Chevrolet Impala is susceptible to damage of a kind not previously seen in IIHS's corner-impact crash test program. Frontal crashes as low as 10 mph into a wall sometimes result in door-jamming, sealing occupants in the car. A prototype bumper designed by Tayco Development, Inc. and installed on a 1977 Gremlin shows no damage for 5 and 7 mph front into barrier tests, whereas a standard bumper has \$236.20 in damages. A chart of estimated repair costs for 16 1977 model cars with standard bumpers shows up to \$707.34 in repairs estimated for a 10 mph front to angle barrier collision.

by Albert Benjamin Kelley; Brian O'Neill
Insurance Inst. for Highway Safety, 600 New Hampshire
Ave., N.W., Washington, D.C. 20037
1977; 12p

Statement presented before the House Committee on

september 30, 1977

HS-020 781

AUTOMOBILE EMISSION CONTROL - THE DEVELOPMENT STATUS, TRENDS, AND OUTLOOK AS OF DECEMBER 1976

A summary of the current technical status and development trends in the automobile emission control field contains a summary and evaluation of development programs of automobile manufacturers and other organizations involved in the development of automobile emission control technology. Period of time of interest is the 1978 model year and 1979-85 time period following. Most information is based on manufacturers' responses to a request from EPA around the end of calendar year 1976. Fuel economy, cost, and driveability are examined, as well as development trends such as three-way catalysts, fuel metering systems, electronic controls, and non-catalytic engine and emission control technology. Also discussed are space requirements of emission control systems; turbocharging; diesel engine development; and decreased efficiency in reporting developments to EPA. Currently applicable standards for model year 1978, 0.41 HC, 3.4 CO, and 0.4 NOx, cannot be met. Four emission standards are listed according to earliest model year when they can be met. Use of improved emission control technology in conjunction with other technological changes can result in significant improvements in sales weighted fuel economy of future model year fleets. A significant difference exists between systems targeted toward 3.4 CO and 9 CO. Concern is expressed regarding use of the octane improved fuel additive MMT due to reports of deterioration of engine-out HC emissions and catalyst plugging. The study of emissions of currently unregulated substances continues to be an active area of investigation. Adoption of a non-methane HC standard can possibly increase industry's capability to comply at the 0.41 total HC standard. Development of emission control systems is progressing at a slow pace similar to 1975. An appendix presents a request form and outline for emission control status report.

Environmental Protection Agency, Emission Control Technology Div.
Rept. No. FE-76-01-GA-014; 1977; 649p
Prepared as a report to the Administrator, Environmental Protection Agency.
Availability: Corporate author

HS-020 782

ANALYSIS OF ROAD TRAFFIC ACCIDENTS DATA IN ZAMBIA

Findings are reported for research project begun in Zambia in 1974 on the country's road traffic problems. Data were obtained from the Central Statistical Office in Zambia; figures are based on police reports. Number of vehicles per 10,000 persons has increased from 163 in 1964 to 332 in 1974, an increase of 103%. Road traffic fatalities have increased by 170% from 330 in 1964 to 890 in 1974, while the total number of accidents has increased by 194%, reaching 10,829 by 1974. In 1974 there were 57 fatalities per 10,000 vehicles. Present trends indicate that 1,100 road fatalities are to be expected in 1980 (200 more than in 1974). Average number of fatalities per

tries and about twice that of the European average. No relationship is observed between seasons and accident incidence.

by S. Emenalo; M. Puustelli; A. Ciampi; H.P. Joshi
Publ: Accident Analysis and Prevention v9 p81-91 (1977)
1977; 4refs
Availability: See publication

HS-020 783

INJURIES, RESTRAINTS AND VEHICLE FACTORS IN ROLLOVER CAR CRASHES

Rollover crashes involving 997 automobile occupants of the front outboard seating positions are examined regarding injury levels using the Abbreviated Injury Scale. One of five outboard-front-seat occupants is ejected, with ejection having 30% of the severe injuries, nearly half of the serious or critical injuries, and six out of ten of the fatalities. Rate of serious and critical injury is more than three times that of the nonejected and of fatalities is five times that of the nonejected. Ejected occupants incur a rate of serious and fatal head injuries eleven times as high as nonejected unrestrained occupants. Containment reduces the more serious neck injuries by 71%, fatal neck injuries by 78%, and any spine injury by 44%. Ejection occurs most often through side door glass areas. Belts reduce the frequency of more serious and fatal injuries of nonejected occupants by 55%, and reduce frequency of any neck injury by 25%. Belted occupants do not sustain any serious, critical, or fatal neck injuries, and have few spine injuries. Only 3% of belted occupants are ejected, compared to 25% of the unrestrained. A significant association is observed between increased roof crush and injury levels to nonejected unrestrained occupants that does not appear for restrained occupants. Rate of ejection from convertibles is twice that from other passenger cars. Increased roof crush is not significantly associated with increased frequency of ejection, to specific areas of egress, or to ejection injury severity. Although there are more occupants in heavy than in light cars with roof crush of six inches or more, there is no difference in the more serious injuries or of fatalities between occupants of the two groups of cars. Cars with B-pillars have a significantly lower percentage of occupants with serious injuries. More occupants are ejected through side window areas from cars with B-pillars. For all occupants the rate of fatality is higher in cars without B-pillars.

by Donald F. Huelke; Thomas E. Lawson; Joseph C. March, 4th.
Publ: Accident Analysis and Prevention v9 p93-107 (1977)
1977; 11refs
Availability: See publication

HS-020 784

MOTOR CARRIER ACCIDENT INVESTIGATION. THUNDERBIRD MOTOR FREIGHT LINES, INC., ACCIDENT - AUGUST 11, 1976 - EAST ALTON, ILLINOIS

A motor carrier accident investigation report is made on a

property damage estimated at \$20,000. Probable cause of the accident was reckless operation of the commercial vehicle by an intoxicated driver. Driver admitted having had no sleep for the preceding 48-hour period; blood alcohol level was 0.20%. Post-accident investigation revealed no mechanical defects for the truck, or involvement of the passenger vehicle in accident responsibility. Contributing factors include the carrier's (Thunderbird Motor Freight Lines, Inc.) apathy toward numerous violations by the driver, use of the truck for personal purposes, and noncompliance with the Federal Motor Carrier Safety Regulations on nine counts. The driver was charged with and convicted of reckless homicide and driving while under the influence of alcohol. Photographs of the accident are included.

Federal Hwy. Administration, Bureau of Motor Carrier Safety, Washington, D.C. 20590
Rept. No. BMCS-76-8; 1976; 14p
Report on Thunderbird Motor Freight Lines, Inc., Accident - 11 Aug 1976, East Alton, Ill.
Availability: Corporate author

HS-020 785

MOTOR CARRIER ACCIDENT INVESTIGATION. HADLEY AUTO TRANSPORT ACCIDENT - JUNE 30, 1976 - SALT LAKE CITY, UTAH

A motor carrier accident investigation report is made on a 1976 daytime collision on an interstate highway in Salt Lake City, Utah involving a truck-semitrailer, a small stake truck, and three passenger vehicles. The accident resulted in three fatalities, three injuries, and \$22,000 property damage. Probable cause of the accident was the operation of the truck-semitrailer by a physically incapacitated driver who lost consciousness. The driver responsible for the accident had been exceeding driving time limitations and falsifying his logs in the two-day period before the accident. Failure to take prescribed hypertension medications on the day of the accident, and a history of cardiovascular and respiratory conditions, were also evaluated in connection with driver's loss of consciousness. The auto carrier truck, travelling in the highway's center lane, crossed the median, collided head-on with a Ford automobile, which was hit in the rear by a small truck. Concurrently a Plymouth was struck with wreckage debris, and the combination vehicle, still moving, collided head-on with another Plymouth. Three occupants of the second Plymouth were killed. Accident investigation showed no attempt to apply brakes of the auto carrier, no mechanical failures, and no responsibility on the part of other vehicles involved. The Bureau of Motor Carrier Safety is currently developing guidelines for medical examiners to determine fitness of commercial drivers operating in interstate commerce, including stress, fatigue, and specific medical conditions such as hypertension and cardiac insufficiency. Photographs of the vehicles involved in the collision are included.

Federal Hwy. Administration, Bureau of Motor Carrier Safety, Washington, D.C. 20590
Rept. No. BMCS-76-7; 1976; 12p
Report on Hadley Auto Transport, Accident - 30 Jun 1976, Salt Lake City, Utah.
Availability: Corporate author

HS-020 786

INCREASED TRANSPORTATION EFFICIENCY THROUGH RIDESHARING: THE BROKERAGE APPROACH. VOL.1. FINAL REPORT

Brokerage as a means of promoting, coordinating, and implementing ridesharing as well as improving transportation efficiency by increasing vehicle occupancy, is built on the concept of matching specific individual needs with a broad array of transportation services. Ridesharing offers benefits such as less highway construction, lighter traffic, reduced air pollution, conserved energy, reduced operating costs, better use of property now required for parking, and greater flexibility in the transit system. No insurmountable obstacles appear in marketing potential, although individual adjustments in schedule flexibility are required. The employer-based survey is usually the most effective means of determining information needed for matching, and mail-out questionnaires are a cost-effective way to purge files and update addresses and work times. Maps covering commuter range, street locator lists, and grid systems ease location of residences for respondents. Public records such as city directories are helpful in beginning a matching file. Optical scan forms are suggested for data processing. Ridesharing is often successful when firms show substantial residential clustering some distance from the work site, when top management provides support and incentives, and when data files include a large number of names. Cost comparisons of alternative transportation systems are based on capital, out-of-pocket, and overhead costs, and revenue reductions. Cost advantages include less dead-heading and contributions to tax base. Costing element of carpools should be considered on a mileage basis. Legal and institutional barriers to carpooling involve such problems as current labor production requirements curtailing experimentation with paratransit options. State and public service commission economic regulatory policies virtually prohibit wide development of paratransit alternatives. Policies of insurance companies, the Bureau of Motor Carrier Safety, and the General Service Administration also inhibit carpooling. Strategies for development of ridesharing programs are based on a pilot project in Knoxville, Tenn. Governmental ridesharing programs have most effective overall strategy. Good coordination and promotion are also essential. The worst pitfall involves alienating the market through ineffective organization and promotion. Appendices present a summary of the Knoxville project, legal and institutional issues, and a proposed method for estimating the demand for vanpools.

by F. W. Davis, Jr.; D. J. Barnaby; T. L. Bell; T. C. Hood; F. J. Wegmann
University of Tennessee, Transportation Center, Knoxville, Tenn. 37916
DOT-OS-40096
Rept. No. DOT-TST-77-36; TC-76-018; 1976; 241p 58refs
Availability: NTIS

HS-020 787

GUIDEBOOK ON ANTHROPOMORPHIC TEST DUMMY USAGE

Impact test dummies are used in developing countermeasures to cope with high incidence of safety problems relating to building structures. Parameters of dummy tests are grouped according to representation of a human victim; representation

(transducer or other measurements in the case of the dummy) which occur. Dummies are classified according to sophistication ranging from anthropometric form to impact body blocks and finally to sophisticated anthropometric form to impact body devices used in automotive safety. Dummy tests can be conducted to identify injury patterns, and develop countermeasures and standards. For example, problem identification in child car seat tests, using dummies, indicates shortcomings in car seat design. Problems in architectural glazing materials are difficult to identify by dummy testing, but ANSI Standard Z97.1 has been established based on a simple pendulum test. Countermeasure studies on guard rails and protective helmets identify typical accident scenarios and suggest changes in railing heights and helmet requirements. Countermeasure studies on automotive side impacts can test prototype side door structures; for inflating occupant restraint systems ineffective protection occurs in other than an erect seated position. Standard test procedure for Part 572 dummies is set up to duplicate real crash scenarios. Variables measured during dummy tests range from time; three-dimensional object position, linear and angular velocities and acceleration, to force and movement vectors. Visual and transducer data acquisition require use of high speed motion picture cameras and FM tape recorders. Linear accelerometers and rate gyros are also used. Data analysis involves routing of transducer signals directly through filters onto light beam oscillographs, film or an FM tape recorder, followed by establishment of commonality of different data streams. Large digital computers are used to determine resultant accelerations: 3-dimensional motions and acceleration calculations, corrections for inertia, and computations of performance indicators. An appendix presents a literature review on test dummies and their usage.

by D. H. Robbins

University of Michigan, Hwy. Safety Res. Inst., Ann Arbor, Mich. 48109
NBS-6-9011
Rept. No. UM-HSRI-77-19; 1977; 82p 267refs
Availability: National Bureau of Standards, Office of Housing and Bldg. Technology, Washington, D.C. 20234

HS-020 788

HUMAN SENSITIVITY, INTELLIGENCE AND PHYSICAL CYCLES AND MOTOR VEHICLE ACCIDENTS

A hypothesis describing the effect of possible cyclic fluctuations (Circadian rhythms) of human sensitivity (28 days), intelligence (33 days), and physical (23 days) characteristics on motor vehicle accidents is examined. For the general driving public, a higher rate of accidents (37%) is found to occur on days termed "critical" (days on which the trait characteristics crossed the mean value) than would have been expected from a random distribution (20%). Although the positive half-period (half-period of a cycle above the mean value) of these cycles reflects no significant difference from that predicted, the negative half-period of the sensitivity cycle has fewer accidents (37%) as compared with the predicted rate of 46%. Critical days of the sensitivity and intelligence cycles seem to have the greatest impact on accident occurrence. Consequently, a good correlation appears between proposed cycles and motor vehicle accident occurrences.

by Neal Latman

Publ: Accident Analysis and Prevention v9 n109-12 (1977)

HS-020 789

ESTIMATION OF ALCOHOL FOR NONRESPONDENTS IN ROADSIDE BREATH SURVEYS

The problem of missing data due to refusals in roadside breath surveys is addressed, and ways of correcting bias are considered. Estimation procedures made by interviewers on initial contact concerning each driver's degree of intoxication can be used to correct for bias. Result of interviewers' judgements about consequent donors are used to develop weights for application to refusers, development of which would depend on choice of assumptions about contingent probability relationships among three variables: blood alcohol concentration, judged degree of intoxication, and decision to respond or refuse. An assumption, based on the theory that observers are not separating out effects of drinking and willingness to have a breath test, is applied to data from the U.S. 1973 National Roadside Survey. More reasonable assumptions by observers are expected when dual judgments, forcing separation between drinking effects and willingness to take tests, are employed. BAC levels in excess of 0.10% are found to be over eight times as prevalent in the unmeasured population as they are among respondents. This contrasts with an alternative assumption that non-BAC respondents estimated not to have been drinking are similar in their BAC's to BAC respondents who were estimated not to have been drinking.

by Paul M. Hurst; John H. Darwin

Publ: Accident Analysis and Prevention v9 p119-23 (1977)
1977; 1ref
Availability: See publication

HS-020 790

PROBABILITIES OF INJURY IN ROAD ACCIDENTS

The importance of studying road accidents from the viewpoint of probability is illustrated. Head-on collision casualty information is presented in percentage form for death, serious injury, slight injury, and no injury. Percentage calculations use probabilities of the four injury levels versus velocity change of vehicle. Then a distribution of percentages of head-on collisions within successive equal intervals of relative velocity at impact is figured. Equivalent test speeds (ETS), estimated for head-on collisions, is a scale of equal damage, resulting in erroneous estimates when applied to collisions of unequal size vehicles. A substantial difference between curves for various mass ratios is most pronounced for deaths and least for slight injuries. Numbers of slight, serious, and fatal casualties are determined in part by the number of "damage only" collisions. Injury percentages determined for ratios of the masses of two vehicles ranging from 1.0 to 9.0 agree satisfactorily with results of an analysis of national accident statistics. This method of studying road accidents is suitable for other types of vehicle collisions as well as head-on. Probability curves for all types of accidents are expected to be similar in general form. Probability of injury is comparatively low even at high velocity changes; however above 12.5 mph velocity change, serious injuries and even deaths become an appreciable and increasing proportion of the injuries, and are highly influenced by age and physical characteristics. Study is suggested for uninjured or slightly injured in severe frontal impacts.

by G. Grime

HS-020 791

PEDESTRIAN DEATHS IN RIO DE JANEIRO AND BALTIMORE

Pedestrian fatalities in Baltimore, Md. and Rio de Janeiro, Brazil are compared using medical examiner data. Baltimore traffic deaths studied cover a three-year period ending 31 Jul 1971; Rio cases are limited to calendar year 1970. Population-based death rate for Rio is about four times the rate for Baltimore. In Baltimore, 72% of fatally injured pedestrians were either younger than 10 years old or older than 64, or had blood alcohol concentrations (BAC) of 0.10% by weight or greater. In Rio, only 28% were similarly youthful, aged, or impaired by alcohol. The difference reflects extremely high death rates in Rio among sober adults of working age. Death rate per 100,000 population was 21.3 for males and 5.0 for females in Baltimore, and 41 males to 14 females in Rio. Differences in both length of exposure and degree of hazard for pedestrians are probably involved in differences between pedestrian death rates in Rio and Baltimore. Difference in the number of vehicles per person, 0.1 per resident in Rio compared to 0.35 in Baltimore, does not account for the 20-fold increase in death rates among working age adults with negative BAC's. Difference in death rates is not due to differences in exposure during hours of darkness. Fewer delineated pedestrian routes and traffic lights in Rio than in Baltimore suggest that pedestrian tasks are more difficult in Rio. Degree to which risk-taking may be a function of difficulties imposed by the traffic environment is a complex question that deserves further exploration.

by Susan P. Baker

Publ: Accident Analysis and Prevention v9 p113-8 (1977) 1977; 9refs

Availability: See publication

HS-020 792

A PARAMETRIC STUDY ON HIGHWAY CABLE BARRIER PERFORMANCE AND ITS EFFECT ON VEHICLE REDIRECTION DYNAMICS

A two-part parametric study of the highway cable barrier system and its effect on vehicle redirection is carried out using NRC barrier analysis, as programmed for digital simulation in conjunction with an existing analysis of the vehicle terrain system. The first phase, studying cable barrier response, indicates that post parameters are dominant in controlling barrier response. Post strength and/or deflection afford the only effective means of increasing barrier performance by increasing lateral force response. Improving barrier response by increased post strength, however, may result in undesirable vehicle response by introducing a spin-out condition. The second phase, studying vehicle response, employs simulation of the total vehicle-terrain-cable barrier system. Roll-over condition is the dominant form of instability, and is possibly related to a critical penetration. For a negative curved cable barrier system a roll-over event is predicted following exit from the barrier. Provided that cable penetration into the vehicle fender structure is not excessive, vehicle response generally moves in the direction of improved performance. With component parameters appearing as directly assignable data, the vehicle redirection process by cable barriers can be studied within a total systems content. Applications of the barrier system used in the NRC study to proposed installations for various agencies have been assessed, for example, a proposal

requiring a response evaluation of vehicle interaction with a multiple curved cable barrier system over sloping terrain. Tables summarizing study parameters, diagrammed results, and photographs are included.

by G. L. Basso

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Rept. No. NRC-15885; MER-MS-139; 1977; 72p 20refs

Summary in French.

Availability: Corporate author

HS-020 793

CELLULAR PLASTICS IN TRANSPORTATION

A series of papers discussing various applications of cellular plastics, particularly in the transportation industry, is presented. Topics covered include the following: stationary fixture systems for the automatic filling of a cavity with urethane foam; a new process for controlled gauge, high density foam (mechanically frothed urethane); humid age compression set in high resilience polyurethane foam; application of flexible polyurethane foam for automotive seating; a review of factors affecting durability characteristics of flexible urethane foams; tin catalyst performance in high resiliency foam; auxiliary blowing agents for flexible polyurethane forms; high resiliency urethane foams for automotive seating applications; a new approach to high load-bearing flexible polyurethane foams; factors affecting fatigue in HR (high resiliency) adduct foam (statistically oriented preparation and evaluation); compression set and related properties of flexible urethane foam; structural polyurethane foam reaction injection molding; safety of fluorocarbon blowing agents for polyurethane foams high modulus RIM (reaction injection molding) elastomers for exterior automotive parts; factors affecting the modulus and relaxation properties of liquid reaction molded urethane elastomers; and energy management with urethane bumpers.

Society of the Plastics Industry, Cellular Plastics Division, 355 Lexington Ave., New York, N.Y. 10017

1975; 98p 62refs

Includes HS-020 794--HS-020 809. Papers presented at Society of the Plastics Industry, Inc., 18th Annual Technical Conference Detroit, 6-8 Oct 1975.

Availability: Corporate author

HS-020 794

STATIONARY FIXTURE SYSTEMS FOR THE AUTOMATIC FILLING OF A CAVITY WITH URETHANE FOAM

A stationary fixture system for the automatic filling of a cavity with urethane foam was developed and is described. The method was designed specifically for use in filling the cavity between a freezer cabinet and liner with a low-density, rigid polyurethane foam. Multiple stationary freezer foaming fixtures and a multiple mixhead, high-pressure metering/mixing unit were combined for the first time in this unique operation. With this arrangement, semi-assembled cabinets and liners are fed by conveyor either open side up or open side down into a stationary foaming fixture. In the fixture the cabinet is restrained while urethane chemicals are mixed and poured into the void. The chemicals react and expand to fill the void within a few seconds. The fixture continues to restrain the cabinet until the foam has expanded. Thereupon, the cabinet is

equipment, utilizing stationary foaming fixtures which require fewer fixtures for a given production rate, which generally cost less, which easily adjust to changes in foam cure time by readjustment of the fixture cycle timer only, which allow expansion of the production line easily by installation of additional pre-engineered fixture lines, which allow cut back in production by simply shutting down one or more fixture lines, which minimize overall floor space, which minimize maintenance problems, and which do not effect the balance of the system if shut down; utilizing a high-pressure foam machine with precision and positive displacement metering for maximum blending and pouring efficiency, impingement mixing which eliminates mechanical agitator and minimizes mixhead physical size and weight, an air flush which eliminates expansive and difficult-handling solvents and allows bulk of the material to be flushed into the unit at the end of a "shot" for minimum waste, moderate pressure at the end of the pour nozzles which allows distribution of foam even to the far end of a long container, a mixhead which is operable in any orientation, and extreme versatility in that more than one mixhead can be operated from a single metering unit and mixture control can easily be changed with minimal adjustments; automating the entire line including loading and unloading of fixtures; and, finally, utilizing the urethane foam for its superior insulating and structural properties to effect reduction in overall wall thickness as well as reduced cabinet and liner material thickness. The system is applicable primarily to the foaming of products which are completely enclosed, but similar systems could be designed where the fixture would become part of the mold. Although this system was developed for use in the appliance industry, using the same basic principles a system for filling cavities in automobile floors, doors and deck lids can be visualized.

by John L. McPherson; John G. Cairns
Urethane Facilities Engineering; Mobay Chemical Corp.,
Pittsburgh, Pa.
Publ: HS-020 793, "Cellular Plastics in Transportation," New
York, 1975 p1-4
1975

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Annual Technical Conference, Detroit, 6-8 Oct 1975.
Availability: In HS-020 793

HS-020 795

MECHANICALLY FROTHED URETHANE: A NEW PROCESS FOR CONTROLLED GAUGE, HIGH DENSITY FOAM

The procedure of mechanical frothing as successfully adapted to urethane technology provides a new route to continuous high-density urethane foam with precisely controlled gauge. Unlike conventional urethane foam, where fluorocarbons or carbon dioxide, from the reaction of water and an isocyanate is used as the blowing agent, frothed urethane foam is generated only by mechanical incorporation of an inert gas (with air as the gas of choice). With frothed urethane foam, expansion and polymerization are separated. Mechanically frothed urethane foam is dispensed and coated as the froth at the density desired of the final product. The amount of air in the froth determines its density and consistency (the lower the density, the more viscous the froth). Latent catalysis is desired for the process of mechanically dispersing air in the urethane forming reactants, piping the resulting froth to the substrate to

thickenness, catalyst concentration, and oven temperature are determining factors. Typical cure conditions for a 20 lb/cu ft foam at 1/4 inch thickness is five minutes at 150° C. While the froth is sufficiently unreactive to permit easy clean-up within several hours, best coating results are achieved when the froth is applied immediately upon leaving the delivery hose. Froths with density as low as 15 lb/cu ft can be achieved, but the lowest density for coating speeds of 20 ft/min is about 17-20 lb/cu ft at 0.125 inch thickness to avoid surface roughness. As far as required equipment, only minor modifications are required to convert an SBR latex or PVC plastisol machine to one that will process urethane froths. The system is formulated for the requirements of the specific application. The polyols and isocyanates are chosen to provide adequate physical properties in the absence of water and the strength contributing urea and biuret groups that would have resulted from the isocyanate-water reaction. A preferred component to facilitate frothing is Union Carbide's silicone surfactant L-5612. NIAx Catalyst LC-5613 is the preferred delayed action catalyst to prevent premature gelation. Dry fillers such as calcium carbonate or alumina trihydrate may be used to increase load-bearing properties, to improve economics or by proper choice to reduce combustibility. Specific applications of mechanically frothed urethane are in simulated leather composites, carpet backing, and gasketing-sealants. A few of the possible automotive applications include carpeting, head and door liners, upholstery, firewall insulation, double-skinned roofs, noise control, gaskets and seals, sealants, and extruded energy absorbers.

by L. Marlin; A. J. Durante; E. G. Schwarz
Union Carbide Corp., Tarrytown, N.Y. 10591
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York, 1975 p5-10
1975

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HS-020 796

HUMID AGE COMPRESSION SET IN HIGH RESILIENCE POLYURETHANE FOAM

Results of an extensive laboratory investigation of an experimental HR (high resiliency) polyurethane form and the chemical properties which might bear on its high values of HACS (humid age compression set) are reported. In previous research, the HR foam consistently was shown to have a HACS of 30%-70% (compared to 10%-15% in hot foam). It was found that the HR foam has a high residual free isocyanate content and did not seem to be affected by postcuring. Infrared analysis was used to determine the ratio of NCO to NH which was used as an indication of the free isocyanate available at different stages of cure and under different test conditions. Since all isocyanate active-hydrogen reactions are exothermic, differential scanning calorimetry (DSC) was used to investigate the conditions under which the isocyanate would react. It was found that the size of the exotherm at 230° C as measured by the height of the curve above base line is proportional to the NCO/NH ratio. The next phase of the investigation was the determination of the effect of the HACS cycle on the exotherm at 230° C. It was established that extreme temperature, 121° C, and high concentrations of reactants, e.g. saturated steam, cause the residual isocyanate to react. Also,

was established that the isocyanate is reactive at 64.7° C in high concentrations of reactive vapor (conditions that would be expected to be found in the interior of an automobile). The exothermic reaction at 230° C was determined to be irreversible under the experimental conditions. It was then decided the isocyanate problem might lie in the production, during the blowing reaction, of insoluble urea oligomers of TDI (toluene diisocyanate), part of the isocyanate component of the HR foam. To check this possibility, several ureas were produced from TDI and water. Results of this procedure suggest that the mechanism for HACS involves the production of diamine from the crystalline urea. This material which has increased solubility then reacts with urethane linkages to form urea which is a short-range crossline. The proposed mechanism would predict a linear relation between free amine in the foam and HACS. However, no technique was available to determine the free amine when this investigation was undertaken. Subsequently, it has been established that there is loss of isocyanate and production of amine during HACS. The theory proposed in this investigation contributed to reformulation of HR foams which successfully met the HACS number required in the Fisher Body materials specifications 7-7.

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1975; 3refs

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HS-020 797

THE APPLICATION OF FLEXIBLE POLYURETHANE FOAM FOR AUTOMOTIVE SEATING

The molded flexible polyurethane seat in fulfilling the following requirements for a good seat is discussed: giving good support to driver and passengers in every driving situation and, at the same time, avoiding an excessive "sitting pressure" in the corresponding skin areas; reducing the transmission of vibrations from the car body to the body of the passenger; and maintaining a comfortable seating climate with respect to temperature and humidity. Market and economic factors of polyurethane foams in the automotive industry in Europe and the U.S. are considered with respect to cold-cure (HR) foams and hot foams. By comparison with the U.S., a much smaller share of the potential market in Europe is filled by polyurethanes; and in the U.S., 70% of the forms used have been cold-cure while 90% of the foams used in Europe have been hot foam. Hot foams require higher energy consumption, more floor space for equipment, and more molds in their production than cold-cure foams. However, there are tendencies in the industry today to process cold-cure systems under similar conditions as used for hot foams in order to improve the properties of the foam surface. The processing of hot foam is much more critical than that of cold-cure foam, but it has been proven that processing difficulties are absolutely manageable. Although hot-foam flash represents an undesirable by-product, there are known production techniques to overcome this problem. No crushing step is necessary to produce hot-foam moldings; however, the open-cell structure of hot foam is closely related to its more critical processing. The burning characteristics of hot foam are inferior to those of cold-cure foam; however they can be improved by the use of flame retardant additives. The decisive factor in favor of hot foam is

its higher bearing capacity compared to that of HR foam. This can lead to weight savings of up to 30% for a molded seat. Lower raw material costs per pound are found with hot foams. Other points in favor of hot foams include higher damping capacity and less effect on them by humidity at elevated temperatures. Most often higher elasticity is mentioned as the most important factor in favor of cold-cure foam. The trend today in Europe is in favor of cold-cure foam because of its higher comfort, its better combustion characteristics, and safer production.

by J. Ick

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Publ: HS-020 793, "Cellular Plastics in Transportation," New York, 1975 p16-9
1975

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HS-020 798

A REVIEW OF FACTORS AFFECTING DURABILITY CHARACTERISTICS OF FLEXIBLE URETHANE FOAMS

A review is made of factors affecting durability characteristics of flexible urethane foams for commercial automotive and furniture cushioning applications. The chemical relationships involved in formulating flexible urethane foams which play a very important role in the attainment of desired physical property and durability characteristics include the following: composition of the foam system (polyether, isocyanate), chemical blowing agent, mechanical blowing agent, surfactant, and catalysts. Some of the primary physical properties which relate to performance of flexible foams in cushioning applications include density, hysteresis, load bearing, and compression set. The nature of the environment foams are exposed to during production, testing and in commercial applications is discussed from the following standpoints: effect of curing conditions on load bearing effect of test conditions on load-bearing measurements, effect of test conditions on flex fatigue, effect of physical and environmental test conditions on compression set characteristics, and effect of test conditions on humid aged molded foam properties. The utility of accelerated aging and fatigue tests for measuring comparative durability responses of flexible foams to changes in composition, processing or application is discussed, and the complexity of trying to predict characteristics of flexible foams in various cushioning applications from accelerated fatigue test data is illustrated by results of various research.

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HS-020 799

TIN CATALYST PERFORMANCE IN HIGH RESILIENCY FOAM

The performance of various tin catalysts in the production of high resiliency (HR), flexible urethane foam was investigated. Four organotin carboxylates (esters of acetic, lauric and oleic acid (M&T Catalysts T-1, T-12 and CN-447, respectively), and dibutyltin bisisocytymaleate (M&T Thermolite 25) and four organotin mercaptides (dimethyltin, dibutyltin, and diethyltin isocetyl-mercaptocacetates (M&T Catalyst T-40, Thermolite 31 and Thermolite 831, respectively), and dibutyltin bis (lauryl mercaptide), M&T Thermolite 20) were evaluated with respect to their effects on processability and foam properties. One objective of the study was to define a catalyst which will broaden the tin latitude available to HR foamers, as measured by absence of shrinkage and high air-flow values, and the second to define the effect of catalyst structure and type on key HR foam mechanical properties, thereby determining whether the traditional use of Catalyst T-12 represents the best choice for this system. Most obvious of the all the findings is that the choice of organotin catalyst, even at the low usage levels typical of the HR foam, has a dramatic influence on foam properties. While no single catalyst performs best in every category (e.g. hardness, tear strength, tensile strength, elongation, compression set, humid aged load loss, air flow), it can be seen that Thermolite 25 and Thermolite 20 represent the best choices representative of organotin carboxylates and organotin mercaptides, respectively. Thermolite 25 is equivalent to or better than the other organotin carboxylates in five of the seven performance properties measured. Thermolite 20 similarly performs in four of seven. Which of these catalysts one uses will depend upon the specific mechanical property to be upgraded. It is recommended that Thermolite 20 be used where extra individual load increase is important, and Thermolite 25 where processing latitude is too narrow.

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HS-020 800

AUXILIARY BLOWING AGENTS FOR FLEXIBLE POLYURETHANE FOAMS

Performance of auxiliary blowing agents for flexible polyurethane foams in relation to their physical properties as an aid to designing the most economical agent possible is explored. Auxiliary agent R-11 (trichlorofluoromethane) universally accepted, is used as a standard of reference. If attention is confined to single compounds that meet the basic requirements for an auxiliary agent for flexibles, that are nonflammable, relatively low in toxicity, unreactive to the other foam ingredients, and with a boiling point between 20° C and 50° C, only R-11 and methylene chloride qualify. If the possibility of mixed agents is accepted, a list of candidate blending agents include the following: R-11, methylene chloride, methyl formate, ethyl chloride, isopentane (also pentane, pentanes), diethyl ether, isopropyl chloride, vinylidene chloride, and trichlorotrifluoroethane (R-113). With regard to flammability,

and only the fluorocarbons possess any significant inerting power. Even so, such otherwise attractive ingredients as the hydrocarbons and diethyl ether lose their obvious advantages of low cost and low molecular weight because so little can be tolerated without becoming hazardous. Molecular weight is the major key to economical gas generation. After optimization of gas utilization, there remains a very substantial difference between the performance of R-11 and methylene chloride that is noteworthy. The fundamental reason for the difference lies in the strong solvent power of methylene chloride coupled with its relatively low volatility. These result in a substantial proportion (about 30%) of the methylene chloride never vaporizing but remaining in the dissolved state in the cell walls of the foam. In spite of its incomplete vaporization and disadvantages of its higher solvent power, methylene chloride has economic value, the consensus of opinion holding that it is a satisfactory blowing agent up to about 3-4 parts per hundred of resin. The obvious combination for a blowing agent is a mixture of R-11 and methylene chloride, keeping the absolute concentration of the latter below about 4 parts and using R-11 for any additional agent required. From both an economic and technical view, combinations of R-11, methylene chloride, and ethyl chloride appear most attractive. Measurement of gas efficiencies of ternary combinations of these materials revealed a surprising and unexplainable maximum. The composition corresponding approximately to the maximum in gas efficiency with 50% R-11, 30% methylene chloride, and 20% ethyl chloride has been selected for commercial development as Freon HE. The vapor pressure and boiling point of Freon HE are nearly the same for R-11, suggesting the possibility of direct replacement for R-11 without significant change in catalysis or in cell control. Because of its much lower average molecular weight compared to R-11 and its unusual gas efficiency, only 65-70% as much agent is required to give the same density obtained with R-11. The value of Freon HE in the molded foams of interest to the automotive industry is still under study.

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HS-020 801

HIGH RESILIENCY URETHANE FOAMS FOR AUTOMOTIVE SEATING APPLICATIONS

Studies demonstrate how the combination of both formulating and mechanical processing techniques can be utilized to broaden the range of high resiliency (HR) urethane foam hardness, and evaluate how formulating and mechanical changes affecting the load-bearing properties of HR foams affected the crushing and breathability characteristics of automobile seat cushions at demold. Polymer-polyols are a unique class of reactive intermediates in that they substantially raise ILD [Isocyanate level density] values without having a major effect on foam density. In addition, polymer-polyols provide a processing advantages, since they increase the open-cell character of foams at demold and reduce the energy required for crushing. An increase in isocyanate index level for a HR foam formulation has a positive effect on load-bearing proper-

character of the foams at demold is enhanced by higher levels of isocyanate index. The density and ILD values of molded foams may be reduced significantly by the addition of fluorocarbon blowing agent to the formulation. Coincidentally, the closed-cell character and crushing pressure of the foams at demold are reduced. Variations in the water level of a formulation affects the molded foam density and modulus of the urethane polymer. These changes can be influenced by the degree of mold overflow or packing, as a method of controlling foam density. Under conditions of minimum mold fill, foams based on formulations of lower water levels exhibit higher load-bearing properties. At constant foam density, ILD values are increased with formulations of higher water level. Both an increase in the formulation water level and an increase in mold overflow result in a greater closed-cell character of foams at demold.

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HS-020 802

A NEW APPROACH TO HIGH LOAD-BEARING FLEXIBLE POLYURETHANE FOAMS

A new approach toward making low-density, flexible, polyurethane foams with an enhanced load-bearing property, desirable for automobile seat cushions and use in the furniture industry is described. These foams are prepared by the concomitant use of polyols containing some primary hydroxyl end groups and tin catalysts without the amine co-catalyst normally used in standard one-shot water-blown formulations. Load-bearing capacity increases with an increase of the primary hydroxyl content of the polyol and a decrease of the 2,4- to 2,6- isomer ratio of TDI (toluene diisocyanate). Although flexible foam with enhanced firmness can be made with any conventional polyether polyol normally used for flexible products, foams made with polyether polyols having from 40% to 70% primary hydroxyl content are particularly useful. Foam preparations with essentially all secondary hydroxyl-containing polyols are relatively slow reacting and may, therefore, be impractical for commercial use. On the other hand, foams with essentially all primary hydroxyl-containing polyol are more difficult to process. Therefore, the polyether polyols having from 40% to 70% primary hydroxyl content should be of particular interest to the formulator who is interested in following this approach.

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BASF Wyandotte Corp., Urethane Chemicals R&D
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1975; 2refs
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HS-020 803

FACTORS AFFECTING FATIGUE IN HR ADDUCT FOAM - STATISTICALLY ORIENTED PREPARATION AND EVALUATION

A detailed, statistically designed study is made of fatigue in high resiliency (HR) foam made with adduct isocyanate (HLG-3897, the reaction product of a polyamine with excess HYLENE TM-65 (a distilled isomer blend of 35% 2,6-toluene diisocyanate). (One of the demands more recently made on HR foams is improvement in fatigue resistance as applied to automotive seating.) Fatigue was monitored using a static fatigue test which correlates well with in-use testing. It has been shown that the polyol and the catalyst have a significant influence on the fatigue characteristics of this foam system. Polyol molecular weight, functionality, and chemical structure (e.g. percent primary hydroxyl) were found to be important in determining the effect of a given polyol system on fatigue. Within the scope of this study, a nominal 6500 M.W. primary triol gave the best fatigue resistance. Catalyst had an equally important effect on fatigue. This phase of the study demonstrated that adduct isocyanate is an excellent processing aid allowing study of a wide range of catalyst systems, some of which would be insufficient for adequate processing in many HR foam systems. An optimum catalyst system for fatigue resistance consists of no more than 0.01 parts DBTDL (dibutyl tin dilaurate), approximately 0.2 parts Dabco 33LV (triethylenediamine, 33% solution in dipropylene glycol), and 0.1 parts Nix A-1 (amine catalyst). System variables such as water level, index, and surfactant have only a minor effect on fatigue in a polyol and catalyst optimized system.

by H. W. Wolfe, Jr.; D. F. Brizzolara; J. D. Byam
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Wilmington, Del. 19898
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HS-020 804

THE COMPRESSION SET AND RELATED PROPERTIES OF FLEXIBLE URETHANE FOAM

Data obtained during compression set tests of high resiliency (HR) urethane foam are given, and the relationship of the compression set to other properties of interest in automotive seating applications (the viscosity and its dependence on the temperature, the glass transition temperature, and the energy of activation for viscous flow) is analyzed. The test data indicate that the compression set takes place rapidly at first and then slows down until a point is reached where a rapid rate is resumed, leading abruptly to high set values. An equation is derived which represents the relationship of time, temperature, and deflection in compression set of HR foam, applicable over a broad range of flexible urethane foams of interest in automotive seating applications. Other equations are subsequently derived which show the dependence of the viscosity on temperature, the energy of activation for viscous flow, and the glass transition temperature. The following assumptions are implied in these derivations: the viscosity-temperature relation-

13th power poises. And, all deformations including compression set and creep involved only viscoelastic flow.

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1975; 6refs
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HS-020 805

STRUCTURAL POLYURETHANE FOAM REACTION INJECTION MOLDING

The fundamental characteristics of reaction injection molding (RIM) and the structural polyurethane foam produced with this process are discussed. By definition, RIM is simply the combination of two or more liquid streams mixed together and injected into a closed mold where a chemical reaction takes place to form a structural urethane polymer. Some general comparisons are made between the more commonly known processes for production of thermoplastics and conventional high-density urethane and those processes of RIM. Thermoplastic structural foams use high molecular weight polymers whose composition has been predetermined and cannot be easily altered without risking decomposition. In RIM, a new polymer, formed during the molding cycle, can be designed to fit each new specific end-use application and because urethanes offer many polyols of varying degrees of functionality, complexity and molecular weight, one can produce almost any type of urethane polymer desired. With RIM, as opposed to the thermoplastics processes, excessive amounts of energy are not required for melting, processing conditions are generally near room temperature, less massive molding equipment and tooling are required, molds are held at constant temperature and are immediately reusable after part removal, and unfinished parts have excellent surface quality and demolding times. Processing variables and chemical components in the production of conventional urethanes and structural urethanes which contribute to their difference in skin thickness (0.5 mm and 0.5-4.0 mm, respectively) are compared and include the following: blowing agent (fluorocarbons of the refrigerant 11 type of structural, and carbon dioxide for the conventional), polyol component, catalyst(s), and surfactant(s). With regard to physical properties of structural foams based on polypropylene, high-density polyethylene, impact polystyrene and polyurethane, structural urethane compares very favorably in flexural strength, flexural modulus, tensile strength, and heat distortion temperature even when using a general purpose formulation. Shore D hardness is better than most common construction woods. Structural urethane also develops physical properties at least 50% higher than equal density conventional urethanes. Tooling costs can be significantly lower with structural urethane, being as little as 1/3 to 1/2 of that necessary for thermoplastic injection molds. Part weight varies from less than 1/2 kg up to 100 kg; part thickness (3-100 mm) is substantially greater than that of injection molded thermoplastics (6-8 mm maximum) and as high as the thermoplastic structural foams, but with faster demolding times. The regard to machinery, a structural urethane machine can be as low as 1/3 to 1/2

cost competitive. Some specific applications of structural urethane foams include the following: energy management systems, instrument panels, chair shells, auto trunk lids, computer housings, tractor trailer sides and tops, stereo speaker boxes, TV cabinets rigid shoe soles, window frames, and other exterior house trim.

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HS-020 806

THE SAFETY OF FLUOROCARBON BLOWING AGENTS FOR POLYURETHANE FOAMS

The toxicology of Fluorocarbon 11, a widely used auxiliary blowing agent in the manufacture of flexible polyurethane foams and the primary blowing agent in rigid foams, is reviewed in relationship to the Threshold Limit Value (TLV), the airborne concentration of a substance representing conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect (for an 8-hour workday, 40-hour workweek). Fluorocarbon 11 has a TLV of 1000 ppm, finding it in a group of compounds at the less toxic end of the scale for toxic materials. Simultaneous use of a portable organic vapor analyzer and conventional "grab" sample containers provides a reliable on-the-spot survey of fluorocarbon blowing agent concentrations in air in thermoset foam plants. Several polyurethane foam and formulation premix plants were surveyed in this manner. All measurements of fluorocarbon vapor in normal breathing air zones were found to be below the TLV. Several observations made during the field measurements which may be useful to the industry are presented. Fluorocarbon vapors are heavier than air. Conditions permitting, they tend to accumulate at floor level. This is particularly true under still air conditions, for instance in curing racks. The most efficient way to ventilate such a building is through ducts drawing out air at floor level. Roof-mounted ventilation without such ducts is much less effective. Local areas of poor ventilation are sometimes found, even though the building ventilation is completely adequate to maintain low average fluorocarbon concentrations. A pedestal floor fan provides excellent dilution in such cases, and is a simple and portable solution to local concentrations. Poorly ventilated adjacent rooms or facilities can be overlooked. Test facilities and laboratories are examples where concentrations can be higher than in the operations area.

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HS-020 807

HIGH MODULUS RIM ELASTOMERS FOR EXTERIOR AUTOMOTIVE PARTS

The use of high modulus RIM (reaction injection molding) elastomers to replace sheet metal in exterior automotive parts is considered, particularly incentives, cost/energy factors, processing requirements, and development efforts. To summarize, RIM high modulus systems are excellent candidates for automotive exterior body parts because of their inherent resilience and corrosion resistance, low weight, long-term price competitiveness, existing proven technology for automotive production, availability of raw materials, and impressive energy savings over its competitors. Adequate physical properties have already been generated on experimental systems to warrant a closer look for the automotive industry for replacement sheet metal parts.

by W. A. Ludwico
Mobay Chemical Corp., Penn Lincoln Pkwy. West, Pittsburgh, Pa. 15205 p75-81
Publ: HS-020 793, "Cellular Plastics Transportation," New York, 1975 p76-81
1975; 11refs
Presented at Society of the Plastics Industry, Inc. 18th Annual Technical Conference, Detroit, 6-8 Oct 1975.
Availability: In HS-020 793

HS-020 808

FACTORS AFFECTING THE MODULUS AND RELAXATION PROPERTIES OF LIQUID REACTION MOLDED URETHANE ELASTOMERS

The effects of specific intermediates on the physical properties of a series of typical liquid reaction molded (LRM) urethane elastomers were investigated. Urethane elastomers are considered block copolymers of the (AB)n type. The A segment or soft segment is a relatively high molecular weight, flexible polyester or polyether (in this study, polymers/polyols of molecular weights 7650, 6000, 3750). The B segment or hard segment contains a high concentration of urethane groups generated from the reaction of a low molecular weight chain extender (in this study, PDA (N-phenyl diethanolamine, ethylene glycol, 1,4-butanediol) with an isocyanate (in this study, TDI (tolylene diisocyanate) quasi and MDI (4,4'-diphenylmethane diisocyanate) quasi). The chemical structure of these segments coupled with the extent of their mutual compatibility determine the physical properties of the urethane elastomers. The intermediates were systematically varied while the modulus-temperature, stress relaxation, and the ability of the elastomers to maintain their configuration at high temperatures were investigated. Increasing the polyol molecular weight decreases the compatibility between the hard and soft segments of the elastomers. As the sample temperature increases, the cross-link density becomes more important with respect to polymer physical properties. The presence of PDA in the polymer system decreases the effective intermolecular interaction between chains. The asymmetric nature of the isomeric

TDI isocyanate becomes increasingly important as the sample temperature is increased.

by M. L. Evans; F. E. Critchfield; R. M. Gerkin
Union Carbide Corp., Chemicals and Plastics Res. and Devel. Dept., South Charleston, W. Va. 25303
Publ: HS-020 793, "Cellular Plastics in Transportation," New York, 1975 p82-6
1975; 2refs

Presented at Society of the Plastics Industry, Inc. 18th Annual Technical Conference, Detroit, 6-8 Oct 1975.
Availability: In HS-020 793

HS-020 809

ENERGY MANAGEMENT WITH URETHANE BUMPERS

Design and processing advances in elastomeric automobile bumpers, have been made in the last three years. One development has been bumper systems, named Davisorb, which are made up of a thin, separately molded skin covering a system of foam energy-absorbing blocks mounted on a rigidly attached reinforcement or load transfer bar. This arrangement allows each element to be made of materials and by processes most suitable for its unique function and allows the flexibility of designing the skin to be anything from a simple blade bumper cover to a full front or rear fascia including lower valances and upper header panels. The system of energy-absorbing blocks may be anything from a single-shaped block of low-density foam to a series of as many as seven or more separate blocks of foam of multiple materials and densities. The Davisorb designs all share the following advantages: low cost, low weight, freedom of bumper design shape, excellent energy management, damage resistance of the bumper itself, integration with fascia and extensions, more effective aerodynamic shapes, and greater freedom to make surface contour changes. Several bumper designs (integral ribs, energy absorbers and ribs, energy absorbers and fillers, unitized energy absorber/filler) have been successful; one is currently in successful production on a number of car lines; the others have undergone extensive development and passed Federal specifications and met commercial standards. The development of reaction injection molding (RIM) allows elastomeric bumper covers to be currently produced with fast processing cycles (three minutes), automated operations, and using lower cost materials than possible in injection molding. The performance characteristics that are required and the physical properties which have been met to fill these requirements for three distinct types of urethane components in bumper design (elastomeric skin covering; the discreet or primary energy-absorbing blocks selectively located behind the skin; and large, low-density fillers that function as secondary energy-absorbing components) are described.

by Peter A. Weller; H. A. Silverwood; J. V. Scivo
Davidson Rubber Co., Inc., Industrial Park, Dover, N.H. 03820
Publ: HS-020 793, "Cellular Plastics in Transportation," New York, 1975 p87-94
1975; 5refs
Presented at Society of the Plastics Industry, Inc. 18th Annual Technical Conference, Detroit, 6-8 Oct 1975.

HS-020 810

A USER'S GUIDE TO POSITIVE GUIDANCE

Positive Guidance is a high payoff, short-range way to enhance safety of substandard facilities. This approach joins highway engineering and human factors technologies to produce a motorist information system matched to facility characteristics and driver attributes. It is based on the premise that drivers are most likely to avoid hazards when they are given sufficient information where they need it and in a usable form. Human factors principles are considered in developing the Positive Guidance concept. The control, guidance, and navigation levels of driver performance; primacy of information; driver expectancy; catastrophic and noncatastrophic system failures; hazards; decision sight distance; and finally positive guidance information are all defined. These definitions are the basis of the analytic tool, Positive Guidance. This User's Guide presents a Positive Guidance procedure consisting of six major functions. Functions A, B, and C, concerning respectively collection of data, specification of problems, and definition of driver performance factors, relate primarily to problem definition and analysis. Function A and B emphasize highway engineering techniques while Function C involves human factors techniques. Functions D, E, and F relate to design and evaluation of Positive Guidance solutions. These functions are respectively concerned with definition of information requirements, determination of Positive Guidance information, and evaluation. Function D continues the human factors concern for motorist's information needs while Functions E and F use engineering techniques to design and evaluate the information systems to meet these needs. Three case studies are presented to support the Positive Guidance procedures. These are located at an urban signalized intersection, at an interstate (freeway) segment, and at a rural, two lane roadway.

by Theodore J. Post; H. Douglas Robertson; Harold E. Price
BioTechnology, Inc.
Contract DOT-FH-11-8864
1977; 172p
Availability: GPO

HS-020 811

**SAE HIGHWAY TIRE NOISE SYMPOSIUM
PROCEEDINGS, SAN FRANCISCO, NOVEMBER 10-
12, 1976**

A series of papers is presented which deals with the factors, and their interactions, that affect the performance of tires in doing their intended function, with special emphasis on the relationship of these factors in regard to the potential for reducing highway tire noise, or that portion of community noise. Discussions are divided into the following sections: heavy truck tire selection and use, functional requirements for light vehicle tires, tire sound measurement, tire sound generation mechanisms, related performance characteristics, and regulatory and enforcement characteristics. Included in the appendices is a list of SAE papers published over the past ten years which are pertinent to the subject of highway tire noise.

Society of Automotive Engineers, Inc., 400 Commonwealth
Dr., Warrendale, Pa. 15096
Rept. No. SAE-P-70; 1977; 306p 197refs
Availability: SAE

HS-020 812

KEYNOTE ADDRESS [TIRE NOISE SYMPOSIUM]

The evolution of truck noise standards and the administration of noise regulations are reviewed. In 1954, the Automobile Manufacturers (AMA) adopted a voluntary truck noise standard of 125 sones, measured at 50 ft under maximum noise-producing test conditions. (In 1957, the Society of Automotive Engineers (SAE) adopted Standard J672 with the same requirements.) The numbers established were arrived at through jury test and were completely subjective evaluations of noise levels and good engineering practice. In the early 1960's, state regulatory efforts were begun in an attempt to bring about control of traffic noise, truck noise in particular. In 1963, the American Trucking Associations, Inc. (ATA) conducted a series of truck noise tests. The ATA study was the first report in the open literature that identified contributions of engine-related noise and tire noise to overall truck noise. It was recommended that tire manufacturers devote more effort to control of truck tire noise by designing quietness into truck tires. As a result, in 1964, the tire industry took its first steps toward setting up internal guidelines for dealing with truck tire noise. Summaries of an industry study (results never published) indicated that tire noise was the major source of annoyance in about 40% of the trucks which passed by a judgment point. In 1968 the General Motors Proving Ground made a study which was the first to provide a consistent set of controlled parametric measurements regarding the noise levels generated by truck tires operating on a variety of road surfaces, which clearly indicated the effects of speed, load, and wear on tire noise and noise level differences among several tread types. Next, simultaneous steps were taken by the SAE Truck Noise Subcommittee to develop a test procedure and a recommended sound level for truck tires, and by the Department of Transportation (DOT) to develop an extensive series of tire noise tests to ascertain the more fine-grain elements of the matrix which had been initiated in the GM study and to broaden the information base within the open literature. With respect to administering noise regulations, California, for example has in-service noise limits which have put a partial lid on tire noise, but enforcement has been limited. In 1971, the California legislature addressed the issue of new product regulations for tires and stipulated that regulations were to be developed by the California Highway Patrol and filed with the legislature eight months after the Federal study on tire noise is available, and that such regulations were to become effective one year after such filing. The Environmental Protection Agency (EPA), shortly afterward, started a comprehensive study of noise to make recommendations for Federal legislative action. At the time of the Noise Control Act of Fall 1972, information was insufficient to justify the immediate development of regulations regarding tire noise. In conclusion, it is hoped that sufficient information is presently available to address the many factored problems of tire noise control.

by W. H. Close
Department of Transportation, Washington, D.C. 20590
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p1-4
1977
Availability: In HS-020 811; SAE

HS-020 813

QUIET TIRES--AN OVERVIEW

Vehicle and tire manufacturers are currently working to produce quiet commercial vehicles and tires. While much time has been spent by both government and industry to gather data on ways to cut down on vehicle noise, it seems that industry and government now wish to interpret these data and make use of them in a short period of time. It is impractical for industry to assimilate the findings in an abbreviated period and then act to an imposed timetable to use the knowledge to meet restrictions without introducing cost penalties to the user. The initial investment of new tires, the labor involved and, importantly, the national availability of these products (quieter radial or straight-rib tires) as replacements must be considered. Only with the full cooperation of government, manufacturers, and the transportation industry can this be accomplished.

by D. R. Bob Watson

Global Van Lines Maintenance Facility

Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise

Symposium Proceedings," Warrendale, Pa., 1977 p7-8

Rept. No. SAE-762000; 1977

Availability: In HS-020 811; SAE

HS-020 814

ECONOMIC AND MOBILITY CONSIDERATIONS IN TRUCK TIRE AND RETREAD SELECTION

A fleet tire program is stated in terms of general objectives, specific application factors, and concept factors related to economic and mobility considerations in tire and retread selection. The general program objectives include using products and procedures which will result in satisfactory safety, legal compliance, customer and driver acceptance, and product and vendor service. These general objectives must contribute to minimum long-term total transportation costs for direct tire and retreading costs and indirect associated costs of maintenance, fuel and weight. Specific application factors include expected static and dynamic loads to be carried on each tire and each axle. These criteria will normally determine minimum tire size and ply rating. The ratio of the weight on the driver axle(s) over the total gross combined weight (GCW) will affect the drive tire traction requirements. Several application requirements demand the use of a high traction, aggressive, self-cleaning tread (e.g. trucks which operate in an unloaded condition in snow or mud). The application must be investigated as to the climatic conditions including ambient temperature. The speed and speed duration that the tires will operate at given ambient and roadbed temperatures are important technical considerations. The terrain and roadbed characteristics including amount of grade, curves, type of roadbed surface must be defined in order to resolve the proper tire solution. Each tire application technical definition must include any unusual or abnormal operation characteristics. Technical concept factors to consider include the following: steel-radial versus bias-ply tire, dual tire versus single tire, straight-rib versus crossbar or aggressive tread tire, and high-tread versus low-tread tire. It is vitally important that the analysis program does not cease with the implementation of the desired solution. A constant reappraisal is necessary in order to determine whether or not the specific solutions are in fact providing satisfactory results and also whether or not the factor decision continue to be valid. The various technical considerations and

application from an economic point of view include the following initial tire cost; expected tread life and associated direct and indirect costs such as repairs, downtime, warranty recover, and fuel or weight savings; and salvage value of the carcass and/or expected recappability.

by Kenneth D. Penaluna; Richard J. Mikes

Ruan Transport Corp.; Ruan Companies

Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise

Symposium Proceedings," Warrendale, Pa., 1977 p9-12

Rept. No. SAE-762001; 1977

Availability: In HS-020 811; SAE

HS-020 815

CURRENT FLEET TIRE ECONOMICS

The experience of the Transcon Lines in the use of bias-ply and radial tires in its truck fleet shows that, based upon original tread wear mileage, the premium cost of radial tires cannot be economically justified. Carcass life in terms of recappability at this time cannot be predicted, and economic justification for the use of radial tires is dependent upon this factor. In addition to lack of economic justification, radial tires present additional problems as opposed to bias-ply tires. Available tread configurations provide insufficient drive axle traction. The tire chain configuration currently used on bias-ply tires will damage the sidewalls of radial tires. Therefore, new tire chains must be designed and purchased prior to converting drive axle tires to radials. There is erratic wear of radial tires when operated on steering and trailing axles. There is difficulty in applying hot-type recaps with radial tires; cold recaps require a good shoulder condition and this is the area where erratic and rapid wear is encountered. It is difficult to repair punctures in radial tires in terms of precluding moisture ingress in the steel belt and carcass cord area. If not completely sealed, moisture ingress results in corrosion of the steel materials and eventual failure. Proper repairs require two to three times as long to accomplish as bias-ply tire repairs. When operating as duals, the radial tire diameters must be mated to much closer tolerances; the same is true for air pressures in dual assemblies. In the event of a carcass failure, the steel elements of the radial tire cause a much higher degree of damage to the equipment. This is especially critical in terms of adjacent steering and brake system components. Radial tires are not readily available in sufficient quantities. Last but not least, the lack of operating experience in the face of a rapid conversion to radial tire usage is a negative factor. Rigid tires used by Transcon Lines were not selected on the basis of extensive testing and evaluation; rather, they were purchased in desperation as a result of recent disappointing experience with the formerly reliable tubeless, bias-ply tire. Data are presented on the operating experience with bias-ply tires from 1970 through Sep 1976. Pertinent fleet facts are summarized for the period 1970-1975.

by B. Bolstad; H. Ames

Transcon Lines

Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise

Symposium Proceedings," Warrendale, Pa., 1977 p13-6

Rept. No. SAE-762002; 1977

Availability: In HS-020 811; SAE

TIRE USE IN A COMMON CARRIER FLEET

The evolution and maintenance of Ryder Truck Lines' tire program are outlined, and the problems financially and time-frame wise in converting large common carrier fleets from one type of tire to another are pointed out. In 1967, 10,000-20 tube-type tires were used by Ryder; based on testing, conversion to tubeless tires was decided in 1969. After converting to tubeless tires, the usefulness of steel-belted radial tires in the tire program was evaluated. Test results in 1973 showed that there was a 3% to 10% fuel savings by using steel-belted radial tires. As far as capability was concerned, 1 1/2 caps were expected with the bias tubeless and 3-4 caps with steel-belted radial tires. The purchase price of a steel-belted radial tire is quite high; however, the cost/mile definitely decreases as the same carcass is capped three or four times versus 1 1/2 tires on the bias tire. Ryder Truck Lines is presently using Michelin steel-belted radial tires with rib-type tread on all axles. With regard to tire maintenance, proper inflation and proper matching of tires are essential. With regard to tire noise levels, the following ranges were determined in pass-by vehicle tests and the slow response method: rib radial, 69 dB(A), cross-bias radial, 72 dB(A), O.E. rib bias, 71-73 dB(A), and cross-bias bias, 75-80 dB(A). The investigation further showed that the following factors have an effect on noise levels generated by tires in use and by the tire maintenance practiced by the fleets: speed, 3-6 dB(A) increase for each 10 mph increase; inflation, higher dB(A) levels with underinflated tires than properly inflated tires with the same load; size of tire, increase of 1-6 dB(A) in sound level with decrease in axle height from 22-20 in.; number of tires on vehicle, increase of 2-3 dB(A) in sound level with doubling of number of tires; stage of wear, increase of 2-5 dB(A) in sound level from new to worn-out stage depending on design; type tread design; lug tires generally 4-9 dB(A) higher than circumferentially-ribbed tires with same ply construction; ply construction, radial tire constructions generally about 2-3 dB(A) lower in noise level compared to comparable tread design in bias tires; road surface, 2-4 dB(A) higher level with smooth concrete surface than coarse asphalt surface; measurement distance, decrease of level 6 dB(A) by doubling measurement distance and conversely increase of same amount in sound level by halving distance.

by H. P. Vollmer
Ryder Truck Lines, Inc.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p17-9
Rept. No. SAE-762003; 1977
Availability: In HS-020 811; SAE

HS-020 817

TIRE DESIGN CONSIDERATIONS FOR REFUSE VEHICLES

Field studies were undertaken by Browning-Ferris Industries (BFI), whose operations involve moving trash from the customer to a landfill, to gather data needed to evaluate the tire design best suited for use on refuse vehicles operating in a sanitary landfill. BFI estimates that on the average its trucks make six trips per day into such an arena; and for that reason, tires satisfactory for conditions encountered there must be used. In choosing such a tire, the fact that many pickups and the trip to the landfill itself will be made on hard-surfaced roads and highways cannot be overlooked. That important consideration is borne out by the fact that, in spite of the slow

conditions encountered at the dump site, BFI estimates its trucks average 18 mph overall and specifies that they be capable of 55 mph top speeds. In an evaluation of the rear tire tread, it was determined that poor tread on the driving tires gave poor results in the landfill. The BFI-designed rear traction tires offered an advantage over not only highway and semi-lug treads, but also over standard depth full cross-lug tires. That advantage was an ability to maintain maximum gripping power. The extreme depth of the lugs allowed above normal lug flexing which resulted in a rapid cleaning tire. It resisted mud and clay caking between the lugs and appeared to have maximum resistance to spinning. Other tests involved the evaluation of front flotation tires in lieu of standard 10.00-20 or 11.00-20 tires in soft, wet landfill terrain. Superior flotation in landfill conditions was provided by 15-22.5 and 16.5 x 22.5 front tires. Using them reduces the tendency of the front end to sink and that results in less rear-tire spin caused by the need to force the vehicle up out of deep front tire ruts. When the front tires sink to the extent their escape angles are no longer relatively low, even an aggressive rear tire tread may be inadequate to keep the truck moving. A very low creeper gear was of no value in preventing or overcoming problems caused by either nonfloating front tires or drive tires with nonaggressive tread. The nature of the terrain makes it more essential to be able to maintain traction when traveling through a landfill than having a creeper gear to assist in trying to get out of the hole once the truck has stopped. The momentum lost when the driver shifts to a very low gear cannot be regained. Further, starting initially in such a gear does not permit speeds high enough to keep the momentum. Very aggressive lug-type drive tires are absolutely necessary for successful operation for refuse trucks in landfills. Banning such tires in the name of noise reduction would result in extremely expensive alternate measures (such as towing all equipment in and out of dump site) being necessary.

by A. H. Berger
Browning-Ferris Industries
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p21-7
Rept. No. SAE-762004; 1977
Availability: In HS-020 811; SAE

HS-020 818

A MANUFACTURER LOOKS FOR QUIET TIRES

Primary consideration of a heavy-service tire for highway-type vehicles, with particular emphasis on tire noise levels, is the 35 mph pass-by test with noise levels measured while the vehicle is in its maximum acceleration. Considering an 83 dB(A) low speed standard, heavy-service tire noise is not a major contributor at 35 mph under the present J366b conditions. The 50 mph coast-by test (SAE J57a) was devised in an effort to separate the various sources of noise emitted by truck tires. Since 1972 much progress has been made by the tire manufacturers toward the development of a quieter-drive axle tire. Because of FMVSS 105 (hydraulic brake regulation), FMVSS 119 (tire regulation), FMVSS (wheel regulation), and FMVSS 121 (air brake regulation), potential maximum noise level requirements must be considered by the tire manufacturer in addition to other criteria such as durability and recaptability. Lower noise level traction tire regulations will have obvious effects on customer demands for certain type tires; because of regulations such as FMVSS 121 and upcoming noise level regulations, it will be impossible for the vehicle manufacturer to honor these customer requests in the future. Low noise requirements will eliminate some of the well-known cross-bar

and cross-lug type tires. Another difficulty to be considered is the noise level produced by recapped tires, because the variety of retreads is great and this is, of course, beyond the vehicle designer's control. Specialty vehicles, such as those used in mining, logging, farming or off-highway operations, might present a special tire problem to the vehicle user. It is to the credit of the domestic tire manufacturer that new quiet-drive axle tires have already been developed and are being prepared for shipment. The new tires, it is hoped, will produce equal or better tread life, tractive effort, superior braking capabilities, and lower sound levels.

by W. D. Long
General Motors Corp.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p29-30
Rept. No. SAE-762005; 1977
Availability: In HS-020 811; SAE

HS-020 819

HEAVY TRUCK TIRE SELECTION AND USE. PANEL DISCUSSION

Radial tires do not perform sufficiently on a high-cube furniture van to warrant purchasing them for this use. A figure of 99.44% is given for that portion of the refuse trucks used in the U.S. (estimate of over 80,000) that is involved in landfill operations. The unsuccessful application of large single tires, instead of dual tires, on the drive axles of trash trucks in landfill operations is pointed out. Regulation of long-dual carriers independently of other vehicles (e.g. trash trucks) with respect to use of lug tires is not supported. The durability, traction performance, tread design, and noise levels of a handcut tire used in refuse truck landfill operations are discussed. Tire noise level regulations with respect to economics, safety, and considerations for the specialized carrier are briefly touched upon. The need for a standard surface upon which to measure tire noise levels is mentioned, and the use of high-speed cleaners for the Federal and state highways is suggested. The effect of terrain and operating area on tread wear is (metropolitan area versus highway) the last topic to be covered.

by E. Clair Hill, mod.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p31-5
1977
Availability: In HS-020 811; SAE

HS-020 820

FUNCTIONAL REQUIREMENTS FOR LIGHT VEHICLE TIRES

Tire selection criteria from a vehicle manufacturer's point of view are reviewed. The selection starts with a definition of the vehicle and a review of the physical and legal requirements that are pertinent. The following factors which are considered in the selection of tires for original equipment use are discussed: vehicle marketing, compliance to Federal standards, ride quality, handling, tire-vehicle uniformity, tire durability, high-speed capability, rolling resistance, skid and traction, tire weight, and miscellaneous factors (e.g. test to evaluate ozone effects on sidewall compounds, curb scuffing tests to compare different sidewall configurations for the degree of protection

establish tire and rim compatibility through an automatic mounter, and tests on new families of tires to determine their run-soft capability (i.e., their tolerance of underinflation, the degree of warning in the form of vibration, noise or handling deterioration given the driver preceding a failure, and the ultimate mode of failure resulting from underinflation)). Any new tire design that is considered for original equipment use is subjected to a wide variety of tests to ensure the expected ride and handling performance of the new vehicle and to provide the optimum combination of tread life, durability, fuel economy, skid and traction all in conjunction with an acceptable noise level. The interrelationships are complex and any significant shift in emphasis has the potential for deteriorating the balance in performance the consumer has come to expect.

by J. H. Schutz
Chrysler Corp.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p39-42
Rept. No. SAE-762006; 1977
Availability: In HS-020 811; SAE

HS-020 821

TIRE PARAMETERS AND TRADE-OFFS

To illustrate the interrelationships and the importance of having a balanced design that provides the best overall tire-vehicle combination for the customer, the results of optimizing each tire parameter (i.e. trade-offs that would have to be made) are discussed. With regard to wear, the result of optimization would be to penalize ride, wet and dry traction, noise, cost, and weight. Optimizing for ride results in a degradation in wear, handling, impact and cut resistance, and rolling resistance. With handling optimized, the result will be a tire that's worse for wear, ride, noise, and cost. With wet traction optimized, losses will result in wear, handling, rolling resistance, and noise. With dry traction optimized, there will be adverse effects on wear, ride, wet traction, impact and cut resistance, rolling resistance, cost, and weight. Providing the best impact and cut resistance will degrade the tire for ride, wet and dry traction, noise, rolling resistance, cost, and weight. Optimizing rolling resistance produces negative effects on wear, ride, dry traction, impact/cut resistance, cost, and weight. Optimizing for noise would result in losses in the areas of wear, ride, handling, wet traction, and impact/cut resistance. It is stressed that trade-offs are involved in tire selection and that care should be exercised to avoid optimizing any one parameter so that the overall quality of the tire is not jeopardized.

by J. D. Velté
Ford Motor Co.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p43-7
Rept. No. SAE-762007; 1977
Availability: In HS-020 811; SAE

HS-020 822

GENERAL MOTORS PASSENGER TIRE PERFORMANCE CRITERIA

An overview of the process of selection, development, and approval of General Motors (GM) original equipment TPC (Tire Performance Criteria) passenger car tires is presented. Detail

procedures used to select the proper size and type for a vehicle. Tire noise requirements are considered in somewhat greater detail. The tire noise test procedures and requirements allow the development of a radial tire with environmental pass-by noise levels no higher than those generated by the bias-belted tires previously used on GM vehicles and interior noise performance that is not objectionable to the vehicle occupants. This can be accomplished without sacrificing performance in all the other areas in which the tire must provide desirable overall vehicle performance. The GM Tire Performance Criteria System covers the following dimensional and performance areas: dimensions (maximum size, static loaded radius, revolutions per mile), endurance, high speed, traction (wet, dry, snow, pass-by noise), force and moment characteristics (cornering coefficient, aligning torque coefficient, load sensitivity, load transfer sensitivity), uniformity (radial force variation, lateral force variation, conicity, plysteer), and balance.

by Kenneth G. Peterson; Fraser D. Smithson; Frederick W. Hill, Jr.

General Motors Corp.

Publ: HS-020 811 (SAR-P-70), "SAE Highway Tire Noise

Symposium Proceedings," Warrendale, Pa., 1977 p49-52

Rept. No. SAE-762008; 1977; Srefs

Availability: In HS-020 811; SAE

HS-020 823

TIRE SELECTION AND PERFORMANCE CRITERIA FOR ORIGINAL EQUIPMENT OF LIGHT VEHICLES

Tire selection and performance criteria for light vehicles, particularly passenger cars, as seen from the viewpoint of an original equipment tire supplier, are reviewed in general terms. The role of passenger car tires in the overall community noise situation is extremely minor. There is almost nothing that can be done to reduce passenger car tire noise below its present level; there does not appear to be any consumer objection to the present noise level, unless squeal is considered as part of tire noise. The noises generated by tires which are perceived inside the car are just as important as the pass-by noise; but because of the complexity of in-the-car noise due to resonance of car components, the attack on this type of noise relates more to frequency shifting than to sound level reduction. Noise is only one of a multitude of factors which must be considered in designing and selecting tires for passenger cars. While noise and other aesthetic considerations cannot be forgotten, those tire performance qualities which relate to safety and economy must be given priority when a trade-off is made if the public is to be properly served by the tire selection process.

by K. L. Campbell

Firestone Tire and Rubber Co.

Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise

Symposium Proceedings," Warrendale, Pa., 1977 p53-6

Rept. No. SAE-762009; 1977; Srefs

Availability: In HS-020 811; SAE

HS-020 824

TIRE SELECTION FOR REPLACEMENT USE ON LIGHT VEHICLES

Selection factors and performance criteria of tires used as replacements on light vehicles (light trucks and passenger cars)

vehicle tires are discussed. The following external systems exist within the limiting constraints of which many product goals must be reached: industry standards of the Tire and Rim Association regarding nomenclature, dimensions, load capacity, operating pressure, and rim contours; government safety standards set out in the Federal Motor Vehicle Safety Standards 109, 110, 119, and 120, and other regulations of the Department of Transportation (DOT), Bureau of Motor Carrier Safety, etc., regarding marking, dimensions, durability in overload performance, durability in high-speed performance, strength, and bead unseating of tubeless tires, etc., and the Uniform Tire Quality Grading System of the DOT; international requirements such as the International Standards Organization (ISO), European Economic Community, and the standards of countries to which products are exported; and the economic and social framework of the various markets in which tire manufacturers operate regarding safety and product liability, price and value, competition, and inadequate maintenance. Within the complex framework of these external constraints, these light-vehicle replacement tires must meet the following performance goals to be marketable: durability of the tire body beyond the life of the tread (recapability); long tread life, without irregular wear and cracking; good tread appearance when new, and during the life of the tread; good sidewall appearance both new and after use, without cracking, crazing, or yellowing of white sidewall; high strength to resist impacts, both in tread and sidewall; good traction, both lateral and longitudinal, wet and dry, braking and accelerating on various pavements and unimproved surfaces, including winter surfaces; soft ride without harshness, imbalance, nonuniformities, etc.; good handling and cornering, straight tracking (without nibbling, side sway, bounce, etc.); low pick-up and retention of stones; good high-speed capability; no objectionable noise; consistency in these performance levels from tire to tire; low rolling resistance; low cost; materials and manufacturing equipment availability; and comparison with competing tires. The interdependence of these goals, often on an inverse basis, is emphasized. With regard to tire noise, manufacturers of light-vehicle replacement tires are cognizant of the tire/road interaction noise, and have reduced its objectionable nature through tire design changes of many kinds. However, solutions have not been found for some of the present noise complaints which result from sheer traffic volume and speed, coupled with light residential building construction, adverse locations of new multi-family dwellings, and now with special-finished Portland Cement concrete pavements with deep transverse tining or scoring.

by J. W. Davis

Cooper Tire and Rubber Co.

Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise

Symposium Proceedings," Warrendale, Pa., 1977 p57-9

Rept. No. SAE-76210; 1977; Srefs

Availability: In HS-020 811; SAE

HS-020 825

FUNCTIONAL REQUIREMENTS FOR LIGHT VEHICLE TIRES. PANEL DISCUSSION

The following topics are addressed: "run soft" capability and driver detection of deflation of radial tires; appraisal methods for tire noise; tire noise resulting from peak frequency versus overall decibel level or sound power generated; benefits of regulations on passenger car tire noise; perception by public of noise generated by vehicles; tire noise generated by light trucks, particularly four-wheel drive light trucks; safety and

noise aspects of road surfaces; and different speed limits for different types of vehicles.

by R. H. Snyder, mod.

Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p61-6
1977

Availability: In HS-010 811; SAE

HS-020 826

EFFECT OF PAVEMENT TEXTURE ON TIRE/PAVEMENT INTERACTION NOISE

Field tests were conducted to evaluate the effect of pavement texture on tire/pavement interaction noise. Sites were selected to provide a range of pavement texture from fairly smooth blacktop (low texture), through a gradation of Portland Cement concrete (PCC) surface finishes (low through high texture). Passenger tire/pavement interaction noise increases with pavement macrotexture (degree of surface roughness). Rank ordering of passenger tire noise can only be sensibly made when it is referenced to a specific identifiable surface. Conventional rib-patterned passenger tire/pavement interaction noise is close to the lower limits as far as the tire contribution is concerned. Conventional patterned passenger tire/pavement interaction noise is relatively insensitive to tread pattern on any one surface. Medium-textured and high-textured road surfaces cause conventional patterned passenger tires to be almost as noisy as snow tires. Conventional patterned tire/pavement interaction noise can be higher than snow tire/pavement interaction noise on high-textured surfaces. Snow tires are significantly noisier than conventional tread patterns on low-textured road surfaces. Snow tire/pavement interaction noise is relatively insensitive to pavement texture. Differing road surfaces can reverse the noise level ranking for two different tires. On low-textured and medium-textured surfaces, patterned-rib tires are appreciably quieter than lug tires. Straight-rib truck tires are not quiet tires when they are running on medium-textured and high-textured road surfaces. Tire/pavement interaction noise should only be evaluated when the vehicle is fitted with the same tires on both the front and rear axle. An important area remaining for investigation is the spectral analysis of the road surface effect relative to the tire effect and their interactions. The gradient in the pavement texture across the roadway as well as along the roadway will definitely be a problem with respect to the reliability of pass-by noise measurements for both trucks and automobiles. It seems doubtful at this time whether any practical significant reduction in noise generation for conventional rib-type passenger and truck tires can be made by any tread pattern or construction change. The only hope for noise reduction in these cases would appear to be in pavement macrotexture reductions. Unfortunately, reduction in pavement texture would deteriorate the wet-traction capability of the vehicle. To avoid most, if not all, of the pitfalls associated with pass-by noise measurements, tires could be certified or labeled as acceptable if they pass a noise measurement test. The test could be made in an environment where the wind velocity and its gradient, the temperature and its gradient, site geometry, turbulence, surface texture, instrumentation, etc., could all be rigidly controlled. This type of test procedure would provide the noise measurement reliability that both the government agencies and industry feel is necessary for reasonable and en-

forceable vehicle noise regulations. (A discussion appears following the paper.)

by D. B. Thrasher; R. F. Miller; R. G. Bauman

B. F. Goodrich Co.

Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p69-79
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Availability: In HS-020 811; SAE

HS-020 827

PASSBY TIRE/PAVEMENT INTERACTION NOISE MEASUREMENT PROBLEMS

Pass-by measurements are extremely important because they are now used for the regulation of motor vehicle noise and in separating out the components of the noise (engine-related and tire/pavement interaction noise). The following factors affect pass-by noise reading: response time setting of the sound level meter; noise from other sources (multiple peaks, clear distance, ambient noise); difference in noise level with direction of travel, and other factors (pavement texture, curbs and guard rails, instrumentation problems, other procedure problems (e.g. lateral deviation of the vehicle which changes the microphone distance, the exact speed of the vehicle at the point at which the maximum value of the main peak occurs). Present vehicle noise regulatory procedure increases the magnitude of many of these errors over that to be expected if the applicable provisions of the already inadequate SAE J57a were followed. Most of the sources of error can result in high readings and many are cumulative. As the acceptable vehicle noise levels are reduced, the errors in reading created by variable site conditions will become more and more serious. Much more thorough work is required before reasonably accurate and repeatable pass-by measurements can be made. (A discussion appears following the paper.)

by R. F. Miller; D. B. Thrasher

B. F. Goodrich Co.

Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p81-7
Rept. No. SAE-762012; 1977; 8refs

Availability: In HS-020 811; SAE

HS-020 828

ROUND ROBIN TESTING WITH SAE J57a

Five tire manufacturers conducted a round-robin test, using the SAE Recommended Practice J57a "Sound Level of Highway Truck Tires," in which eight sets of commercial truck tires were measured at each facility for peak, A-weighted sound levels. Wide variations were found to exist for four of the eight test sites when the same tires were measured at different test facilities in accordance with H57a procedure. The extent of this variation was computed and presented by three simple measures of variability: the range, the maximum difference between means, and the standard deviation. The range of individual measurements for all test facilities combined was as high as 7.3 dB(A) for fast response and 5.9 dB(A) for slow response. The maximum difference between means was as high as 6.0 dB(A) for fast response and 4.9 dB(A) for slow response. The standard deviation of the data sample for all test facilities combined was as high as 2.32 dB(A) for fast response and 2.00 for slow response. These site-to-site variations may be explained by differences in the texture of the test surfaces, as well as the other factors of test site layout, en-

measurements at individual facilities, although usually smaller than site-to-site differences, fell in an approximate range of 1-3 dB(A) and must be considered when assigning a specific sound level to a tire. On the average, the fast response readings were 1.4 dB(A) higher in level and 0.4 dB(A) higher in maximum difference between means. The standard deviations for fast response readings were consistently higher (0.01-0.46), all sound level readings taken by trained technicians at industry sites. It is felt that assignment of a specific sound level to a tire is impossible when measurements are taken at various test sites using the J57a procedure. Appendices contain a comparison of mean sound levels versus reported value per J57a procedure, and a statistical analysis of round-robin data. (A discussion appears following the appendices.)

by D. G. Anderson; T. Benchea; F. E. Matyja
Goodyear Tire and Rubber Co.; Firestone Tire and Rubber Co.; General Tire and Rubber Co.
Publ: HS-020 811 (SAE-P-70) "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p89-100
Rept. No. SAE-762013; 1977; 1ref
Availability: In HS-020 811; SAE

HS-020 829

MEASUREMENT OF TRUCK TIRE NOISE USING A SINGLE-WHEEL TRAILER

Tire noise research at the General Motors Res. Labs. centered around on-the-road testing with a variable-loading, single-wheel trailer consisting essentially of a truck wheel at the end of a forty-foot beam. This approach has proved to be highly satisfactory since it can be used to make realistic tests of the noise from a single truck tire, in isolation from other noise sources and free from interference by echoes from the vehicle structure. Measurement procedures have been developed both for semicircular arrays of microphones on the ground and microphones and accelerometers traveling with the test tire. For the stationary semicircular arrays, a digital analysis procedure has been developed to determine the narrow-band spectra and the radiation patterns of the sound emitted by the moving tire as it passes through the center of the semicircular array. The associated computation includes corrections for the varying source-receiver distance during the time interval of the data, small run-to-run variations in the test conditions, and Doppler shift. In this way the power spectra and the radiation patterns are determined as if the semicircular array were moving with the tire at a fixed radius. For microphones moving with the trailer, signal averaging methods are utilized to reduce background noise, especially wind noise. Also, a new coherence-function method that eliminates wind noise in a system of three microphones has recently been developed and is currently being used for far-field measurements. The tire noise trailer could be used for development work as well as for research. It might also be considered for qualifying tires. (A discussion appears following the paper.)

by I. D. Wilken; R. Kickling
General Motors Res. Labs., Res. Dept.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p101-8
Rept. No. SAE-762014; 1977; 6refs
Availability: In HS-020 811; SAE

A LABORATORY PROCEDURE FOR MEASURING THE SOUND LEVEL OF TRUCK TIRES

An alternate laboratory procedure for measuring the sound level of truck tires to the SAE Recommended Practice J57a "Sound Level of Highway Truck Tires" is designed so as to preserve in the proposed measurements, the pertinence of J57a. Comparative testing of numerous tire designs in the two manners shows that this objective has been accomplished. Rather than presenting the experimental details behind each of the various foundations for the proposed method, discussion is confined to the items significant to the description of the method and to a comparison with the J57a procedure. The method is capable of considerable precision (repeatability generally in the order of plus/minus 0.1dB). The drum test procedure has numerous advantages in flexibility. It offers the opportunity for modification in signal detection and processing in order to account for changing goals in curbing noise pollution. It is quite rapid, thereby accelerating new tire development. It further assists in preliminary explorations of new designs since only one experimental tire is required instead of the four needed for SAE's J57a procedure. (A discussion appears following the paper.)

by S. A. Lippmann; K. A. Reid
Uniroyal Tire Co.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p109-15
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Availability: In HS-020 811; SAE

HS-020 831

ON-BOARD PASSENGER TIRE SOUND GENERATION STUDY. ROAD VERSUS LAB WHEEL

Differences between the tire noise generated on the road and on a lab wheel were studied using the On-Board testing technique which uses a microphone mounted directly on the test vehicle and properly positioned to monitor sound emitted from the rear contact area of the single test tire. An Anechoic Chassis Roll facility was used for the lab wheel, allowing the use of exactly the same vehicle and microphone position for both tests. The only significant differences were the surface curvature and texture, and the absence of wind noise on the indoor lab wheel. Thirteen different carved designs were tested. There were basically three design types: rib, block and lug, with varying void volume. Smooth and rib designs showed a high sensitivity to the change from the flat, asphalt road surface to the curved, steel drum. These tires measured much quieter on the lab wheel. Individually, each rib design showed a relatively high statistical correlation between road and lab wheel. However, these linear relationships varied unpredictably, possibly due to the effects of the interaction between a changing tread geometry (wider groove widths) and different aspects of the surface characteristics. The result is a lower calculated correlation coefficient when the smooth and rib designs are analyzed as a group. The mechanisms of sound generation of the lug and block designs were affected less by the different surface texture and curvature. These more aggressive tread designs showed a near one-to-one correspondence between road and lab wheel and had a calculated correlation coefficient of 0.958 for this limited group. In this initial study, no attempt was made to simulate the road surface texture on the lab wheel, but this is certainly an important area worthy of further investigation. Other future efforts must

surmountable. However, many experimental work remains to be done to determine the lab test conditions that give the best correlation with actual road test sound levels for all tire designs. The advantages of the indoor test, such as controlled test environment, lower testing cost, and convenience, are good incentives to pursue the development of an indoor test. (A discussion appears following the paper.)

by D. G. Anderson; S. P. Landers
Goodyear Tire and Rubber Co.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p117-21
Rept. No. SAE-762016; 1977; 4refs
Availability: In HS-020 811; SAE

HS-020 832

ON-BOARD TIRE SOUND LEVEL TESTING TECHNIQUE

The On-Board tire sound level testing technique is characterized by a near-field measurement of the sound level from a single tire. The microphone is mounted directly behind the test tire within the wake of air flow around the tire. When the microphone is properly positioned, the sound that is measured is predominantly tire sound, with wind, vehicle and other extraneous sounds at a minimum. Microphone position is fixed relative to the test tire throughout the entire test, thus eliminating the Doppler effect (the frequency shifts in sound due to a relative velocity difference, and the changing distance and direction, between the sound source and the measurement position that are present in a coast-by test). Sound level measurements and continuous sound recordings of the test tire are made as the vehicle coasts down through the desired speed range. This continuous measurement technique shortens the testing time and minimizes effects from other variables such as surface temperature, ambient sound level, tire temperature, and surface uniformity. Recordings of the tire sound can be analyzed and presented as a three-dimensional "carpet" plot showing speed, frequency, and sound level. This graphical data presentation enhances understanding of the overall effects of speed on a given test tire.

by S. P. Landers; G. W. Richards; J. L. Bradisse
Goodyear Tire and Rubber Co.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p123-7
Rept. No. SAE-762017; 1977; 4refs
Availability: In HS-020 811; SAE

HS-020 833

PASSBY SOUND LEVEL VARIABILITY OF AUTOMOBILE TIRES

A pass-by tire noise test procedure and specification established as part of General Motor's Tire Performance Criteria (TPC) was designed to permit testing on various road surfaces at different test sites. As surface texture is one of the most important parameters affecting tire noise a "correction" must be made to normalize the data. The "corrected" noise level of a tire is expressed as the difference (in decibels)

with noise levels as low as the bias-belted tires they replace. The use of a control tire to normalize the data is limited to the extent that its noise level varies with road surface in the same manner as does the noise of the test tires. The ASTM skid tire (ASTM Standard Pavement Test Tire E501) was found not to be an ideal noise control tire (with existing road surfaces). Limitations of the control tire procedures, it is felt, can be resolved only by eliminating surface variability. A development program should be undertaken to study the feasibility of testing on a controlled (reproducible) surface. A control tire might still be required to normalize nonsurface variables (A discussion appears following the paper.)

by Michael G. Richards
General Motors Proving Ground
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p129-32
Rept. No. SAE-762018; 1977; 2refs
Availability: In HS-020 811; SAE

HS-020 834

POSSIBLE EFFECT OF VEHICLE AERODYNAMIC NOISE ON SAE J57a PASSBY NOISE MEASUREMENTS

Results of tests to determine the possible effect of vehicle aerodynamic noise on SAE J57a pass-by noise measurements are reported. Vehicles have been coasted into the wind and with the wind so that the velocity of the airflow over the vehicle could be varied while maintaining constant vehicle ground speed. In this way the effect of the aerodynamic noise can be separated from tire noise. Results of successive tests conclude that vehicle aerodynamic noise cannot be ignored in tire noise testing. (A discussion and comments appear following the paper.)

by L. J. Oswald; R. Hickling
General Motors Res. Labs.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p133-6
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Availability: NTIS

HS-020 835

AN INDUSTRY VIEWPOINT OF TIRE SOUND REDUCTION AND MEASUREMENT METHODOLOGY

In order to reduce unwanted sound, tire design engineers have concentrated during the past 45 years on two basic manifestations of noise from tires, one the noise created as the tire rolls along the highway in a straight line, and the other, the squeal which occurs during cornering or braking. By reducing the frequency peaks in the total sound spectrum, annoying concentrations in one limited frequency have been diffused. Even though sound levels may not have been reduced to a great extent by following this approach, the unwanted aspect of tire/pavement interaction sounds has been substantially reduced in tires of current design. The SAE J57a coast-by test, the most prevalent method used throughout the tire industry to

evaluate truck tires for sound generation, is neither desirable nor adequate to assign an absolute and universal level to truck tire/pavement interaction noise. In an attempt to overcome the shortcomings of this test, substantial programs are underway in the tire industry to develop a practical, repeatable laboratory sound level test for tires which can be correlated with actual highway experience. Development of such a test has proven to be somewhat complex, but good progress is being made. A number of tire manufacturers have constructed highly sophisticated anechoic noise chambers with fixtures, chassis rolls, and other equipment for the purpose of developing laboratory test procedures. Cooperation between industry and regulatory agencies is encouraged so that only practical and meaningful tire noise standards will evolve, precluding unnecessary loss of time and money in costly litigation and eventual consumer disservice.

by Frank E. Timmons

Rubber Mfrs. Assoc.

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Symposium Proceedings," Warrendale, Pa., 1977 p137-42

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Availability: In HS-020 811

HS-020 836

THE RELATIONSHIP BETWEEN TRUCK TIRE VIBRATION AND NEAR AND FAR FIELD SOUND LEVELS

Tire sidewall acceleration, near-field sound, and far-field sound levels were measured for tests conducted on two tires (rib and cross-bar) at speeds of 64, 80, and 96 km/h (40, 50, 60 mph) operated at a single load on eight different test surfaces. It was shown that A-weighted sidewall acceleration, near-field sound, and peak pass-by levels follow the same trends and any two of these quantities may be related by a constant for a given road surface. Near-field sound and/or sidewall acceleration provide a meaningful estimate of the far-field sound level. The qualitative effect of road surface on both tire sound and vibration can be audibly detected through monitoring of recorded near-field sound and sidewall acceleration signals. The significant region of tire vibration has a characteristic dimension of approximately 20 cm. The region of the tire in the vicinity of road contact dominates the tire vibration field. Vibration normal to the surface of the tire is coherent with the tire near-field sound. Both tire sidewall and tread vibrations are potential producers of tire noise. Continued investigation of these phenomena is required to further define the tire noise sources. (A discussion appears following the paper.)

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Grant DOT-OS-201-05

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Symposium Proceedings," Warrendale, Pa., 1977 p145-54

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HS-020 837

RESEARCH ON INDIVIDUAL SOURCE MECHANISMS OF TRUCK TIRES: AEROACOUSTIC SOURCES

Results of investigations at the General Motors Res. Labs. on aerodynamic sources of tire noise (gross-flow aerodynamics, and air pumping between the treads of the tire and from small depressions in the roadway) are reported. The gross-flow aerodynamic noise has been shown to be negligible, even for treadless tires. For the noise associated with air pumping between tire treads, investigations have centered principally around cross-bar tires where it was felt that the air-pumping mechanism might be most significant. In addition to on-the-road measurements, the study of the air-pumping mechanism has involved mathematical modeling and simulation tests in the laboratory. The measurements have clearly demonstrated the existence of the air-pumping mechanism and show that it is the major contributor to the noise from the type of cross-bar tire tested. The following suggestions for reducing the noise of the air-pumping mechanism in cross-bar tires are presented: open the closed end of the cross grooves to circumferential grooves, change the tire to place the largest normal pressures (and, hence, the greatest compression rates of the tread rubber) near the closed end of the cross groove, vary the lengths of the cross grooves for different grooves of the same tire, and place the grooves at the largest possible angle to the entrance of the contact path (thus tending to reduce the rate of compression of the groove). (A discussion appears following the paper.)

by I. D. Wilkin; L. J. Oswald; R. Hickling

General Motors Res. Labs., Fluid Dynamics Res. Dept.

Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise

Symposium Proceedings," Warrendale, Pa., 1977 p155-64

Rept. No. SAE-762022; 1977; 7refs

Availability: In HS-020 811

HS-020 838

TIRE NOISE GENERATION: THE ROLES OF TIRE AND ROAD

Laboratory (hemi-anechoic room and roadwheel facility) studies are made to distinguish between tire and road contributions to tire/road interaction noise. Through the use of the signal average, (roadwheel) tire noise may be separated into tire-rotation correlated and roadwheel-rotation correlated components which account for essentially all of the sound. Level and spectral characteristics of these components were examined for three tires with very simple tread patterns and one commercial-type tire. Results suggest that several distinct excitation mechanisms are responsible for "tire vibration" noise. Nonuniformities in the tire (tread pattern, mass distribution, etc.) and nonuniformities in the road (surface texture) excite tire vibration in a deterministic manner. This process accounts for essentially all of roadwheel tire noise. There is no evidence that the suspension system significantly affects tire noise generation; alignment, however, may be important. Legislative regulation of tire noise is, appropriately, based on the concept of coast-by measurements. Though "correct," coast-by measurements are cumbersome and subject to much uncertainty. Laboratory roadwheel measurements offer significant advantages, but, at present, show inconsistent correlation with coast-by measurements. Application of the signal average, as used in this investigation, should help refine roadwheel mea-

tomobile tire noise and legislative regulation may be misdirected at present. For a commercial tire on a roadwheel, the tread pattern is responsible for the majority of tire noise. Reported observations indicate, however, that the road may be responsible for a large portion of the tire noise observed in coast-by measurements on a realistic pavement surface. Further research is needed to clarify this situation so that proper action may be taken; the signal average techniques should be useful in this work also. (A discussion and comment appear following the paper.)

by Joseph Pope; William C. Reynolds
Stanford Univ., Dept. of Mechanical Engineering
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Availability: In HS-020 811

HS-020 839

CROSS LUG TIRE NOISE MECHANISMS

The predominant noise generation mechanisms of cross-lug truck tires (often used on the drive axles of heavy trucks and the principal contributor to exterior truck noise at highway speeds) are studied and tread pattern design guidelines established. Two primary noise mechanisms of cross-lug tires, tread vibration and air pumping, were identified and analyzed experimentally. The system inputs were determined, laboratory simulations run, and experimental tests devised to differentiate between the mechanisms. The conclusions reached are that both air pumping and vibration-caused noise are present in most truck tires. The predominating mechanism depends on the tread pattern, state of tread wear, road surface macrotexture, tire loading, and vehicle speed. The following guidelines are suggested as a basis for further experimental development work: eliminate tread patterns that cause air pumping (can be accomplished by providing multiple paths for the air to escape through, for example, develop a block pattern); if a lug or cross-bar patterns are indispensable for high tread-wear mileage, either randomize the lug spacing as much as possible or randomize the lengths of the grooves between lugs; and if a block pattern, use a good block sequence that randomizes the input excitation, use different (uncorrelated) sequences in adjacent rows or stagger the tread rows to prevent blocks in adjacent rows from hitting the road simultaneously, and use a solid center rib, that is, avoid blocks in the center of the tread area. (A discussion appears following the paper.)

by Michael G. Richards
General Motors Corp.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p181-6
Rept. No. SAE-762024; 1977; 6refs
Availability: In HS-020 811

HS-020 840

A VIBRATIONAL SOUND MECHANISM OF LUG TYPE TREAD DESIGNS

The results of a carved study of basic design parameters using the On-Board noise testing technique indicate that the funda-

damper response which is highly dependent on speed. The tire sound generated by this mechanism is very dependent upon the dynamic characteristics of the tire such as the natural frequency and structural damping. The geometry of the tread design is the sound forcing function for this mechanism. The greater the fluctuations in the tread mass and circumferential bending stiffness, the greater the amount of sound produced. Changes in tire loudness due to changes in speed cannot be predicted solely by the simple "40 LOG V" relationship. Tire resonances can add significantly to the loudness of the sound produced by certain tires. If the resonant speed of a tire is within its operating speed range, there may be problems in trying to rate it for loudness. The single speed at which it is tested and rated may not be representative of its entire speed range. The resonant speed of a given tire is not only a function of the dynamic characterization of a tire's structure, but also of the tread design. The cycle length of the repeating tread design feature determines the period and frequency of the forcing function. It is possible to have more than one resonant speed in a tire. The tire's structure is very complex and has several possible modes of vibration. The forcing function resulting from complex tread designs may contain strong harmonics of the fundamental tread frequency. These harmonics can also excite the resonant characteristics of a tire. As a tire wears, the tire structure will become more resonant. This is because the structural damping, that is the result of the volume of tread rubber being distorted, is being reduced. Also, the natural frequency of the structure may increase slightly, as the mass of the tread is reduced. Both of these effects could cause an increase in the resonant response of the structure and a resulting increase in sound loudness. There are other effects such as a changing tread radius and irregular wear that must also be considered. The tire loudness is affected by the distortion of the tire. This increased distortion can be caused by an increased deflection of the tire due to an increased loading. It might also be caused when a tire is run on a curved surface such as a lab wheel. Finally, aggressive tires with cross-groove-type tread designs are slightly louder when tested on a lab wheel when when tested on a roadway. (A discussion appears following the paper.)

by S. P. Landers
Goodyear Tire and Rubber Co.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p187-92
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Availability: In HS-020 811

HS-020 841

ON GENERATING MECHANISMS FOR EXTERNAL TIRE NOISE

Available tire noise data seem to indicate that external noise emission from tires on dry roads is mainly caused by radiation of vibrations from the tire/road interactions. The following indications of this source mechanism for external tire noise are discussed: speed dependence of random, tonal, and squeal noise; the power spectral density versus speed and frequency (by using a novel data-reducing technique for tire noise); the connection between n and C in the formula $L_{OC} 0.10 n \log(V)$, where L is sound level dB(A), C is regression constant, V is vehicle speed, and n is velocity exponent (all tires and road surfaces constituting a straight line); external noise dependence on the macrotexture of the road; and the connection

pointed out is the possibility of tangential movements of tread elements as a source of high-frequency external noise from tires on dry road surfaces. For wet roads, the tire noise normalized spectrum in the lower frequency region would suggest some turbulent fluid-dependent mechanism while transients from breaking up the water film may be responsible for the noise at higher frequencies. (A discussion appears following the paper.)

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Contract SBDT-74-4745
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Availability: In HS-020 811

HS-020 842

POWER TRAIN, TIRE AND AERODYNAMIC SOUND LEVELS OF AUTOMOBILES AT STEADY SPEEDS

To determine the magnitude and characteristics of the power train and rolling components of total vehicle sound, for automobiles operating at steady speeds, two experimental test series were run, involving different test vehicles, sets of test tires and their carcass construction, and test site. Powered (constant-speed drive-by) and unpowered (coast-by) test runs were made over a speed range of 48-160 km/h (30-100 mph). Peak sound pressure levels and A-weighted sound levels, and third-octave spectra corresponding to the peak sound level, were determined for all test runs and subsequently averaged for each test speed and operating mode. Estimates of the levels for power train sounds were calculated as the difference between drive-by and coast-by levels. Prediction models based on actual regression analyses were formulated for power train sounds and rolling sounds of the individual tire sets. The power train sound is found to vary as the third power of vehicle speed (30 log S), with good agreement to the calculated values except for some anomalous data at low vehicle (and engine) speeds presumably due to acoustic resonances of the exhaust system. Rolling (or coast-by) sounds were found to vary as the fourth power of vehicle speed (40 log S), with very good agreement to the observed sound pressure level and sound level data. Predictions of total vehicle sound, obtained by combining power train and rolling sounds at discrete speeds, showed good correlation with the observed drive-by levels. Only slight evidence of higher-order speed dependence was found in the coast-by data, indicating that contributions of aerodynamic flow sources involving either the vehicle or the tires are not significant at urban or suburban traffic speeds. The fourth power of speed relationship for tire sound intensity, combined with the invariance of spectral shape with speed supports recent hypothesis of tread vibration and radiation as the primary mechanism for automobile tires. Further, the effect of properly designed (nontonal) tread patterns is seen to be small, accounting for perhaps a 2 dB increase in sound levels over those for a blank (untreaded) tire of the same carcass construction. (A discussion and comments appear following the paper.)

by Ralph K. Hillquist

HS-020 843

TIRE NOISE SCREENING

An investigation of the reduction of tire noise emission from road vehicles on dry and wet surfaces by attachment of special screens to the vehicles used a speed range of 30-90 km/h. The effect of screens consisting of side dishes of 3 mm steel sheets with rubber in the outer parts was limited to 1-2 dB(A) and was in some cases not statistically significant. For screens consisting of a complete "skirt" of rubber sheet around the whole vehicle, with an air gap of 50 mm between shield and road, reductions of 7 dB(A) were recorded at 50 km/h and 2 dB(A) at 70 km/h for dry roads, and for wet roads reductions of 1-2 dB(A). (The limited effect at higher speeds could be caused by a too loose screen design.) The third type of screening, local enclosures over the single wheels following the movements of the wheel (with construction air gap varying from 5-100 mm), was found to be more promising. Here reductions of 5 plus or minus 2 dB(A) were reached on dry roads and 2 04/-2 dB(A) on wet roads. When noise absorbing material was attached inside the screens, the reduction increased to 7 plus or minus 3 dB(A) on dry roads and 4 plus or minus 2 dB(A) on wet roads. The investigations of the enclosure properties included technical tests like braking tests, splashing tests and tire-tread temperature influence. The splash was effectively reduced, and the temperature was not critically increased. (A discussion appears following the paper.)

by G. Gadefelt; P. Voight
IFM Akustikbyran AB, Sweden
Contract SBDT-74-4601
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p211-3
Rept. No. SAE-762028; 1977
Availability: In HS-020 811

HS-020 844

THE NOISE AND HIGHWAY TRACTION PROPERTIES OF HEAVY TRUCK TIRES

Noise and highway traction properties of heavy-truck tires are investigated via measurements of peak dB(A) noise levels per SAE J57a, which show bias lug-type tires to be an average of 7 dB(A) higher and radial lug tires 3 dB(A) higher in noise level than tires in the respective constructions with rib-type patterns. Insofar as peak longitudinal traction is concerned, tires exhibiting improved traction performance are generally those whose tread patterns yield lower noise output. Conversely, the tire which exhibits characteristically less desirable peak longitudinal traction properties has been found to be noisier as well. Regarding both directional and longitudinal traction properties, the common usage of bias lug-type tires on rear driving axles (only) results in a typically disadvantageous arrangement, from a vehicle control point of view. The radial-type lug tire, on the other hand, provides lateral force properties which are virtually interchangeable with those afforded by the radial rib, thus rendering no apparent disadvantage to vehicle controllability when installed on driving axles with radial ribs located at the steering angle. Finally, the degree of disadvantage incurred by the bias lug-rear, bias or radial rib-front

configuration cannot be objectified within current technology. (A discussion appears following the paper.)

by Robert D. Ervin

University of Michigan, Hwy. Safety Res. Inst.
 Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise
 Symposium Proceedings," Warrendale, Pa., 1977 p217-26
 Rept. No. SAE-762029; 1977; 7refs
 Availability: In HS-020 811

HS-020 845

POWER LOSS OF TRUCK TIRES UNDER EQUILIBRIUM AND TRANSIENT CONDITIONS

A test program to measure the rolling resistance characteristics of selected 11 x 22.5 truck tires provides a data base which contributes to the understanding of truck tire rolling resistance and its relationship to operating variables. The influences of tire wear, speed, load, torque, slip angle, inflation pressure, temperature, construction, tread pattern and distance traveled on rolling resistance were investigated. The rolling resistance of truck tires was found to decrease with wear; the amount of decrease is about twice as much for bias tires as for radial tires. The rolling resistance was found to decrease with increasing inflation pressure. The rolling resistance of bias-ply tires was found to be greater than that of radial-ply tires; in general, the rolling resistance coefficient is about 50% greater for bias tires than it is for radial-ply tires. Rolling resistance coefficients of a tire measured on a 1.708 m (67.23 in) diameter drum were greater than those measured on a flat road under the same loads. If flat plate equivalent loads were used, then the measured values were more nearly similar. Rolling resistance coefficients of bias-ply tires increased with load whereas for radial tires they generally decreased. Tire replication showed variations in rolling resistance of up to 13% for radial tires and up to 8% for bias tires. Rolling resistance was found to increase with increasing speed. Minimum rolling resistance was found to not necessarily occur at zero wheel torque or zero slip angle. (A discussion appears following the paper.)

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 Calspan Corp.

Contract DOT-HS-OS-60156
 Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise
 Symposium Proceedings," Warrendale, Pa., 1977 p227-39
 Rept. No. SAE-762030; 1977; 4refs
 Availability: In HS-020 811

HS-020 846

THE REDUCTION OF NOISE BY APPLYING BASIC DESIGN PRINCIPLES TO ROADS AND TIRES

Noise level results for a range of types of truck tire-tread patterns and road surfaces are discussed. Some of the results of noise level in dry conditions are related to braking grip in wet conditions, showing that it is possible to increase wet grip and still reduce noise level. Computer studies using the mechanical frequency modulation method of predicting dominant tread pattern frequencies from tread segment pitch variations are dealt with, including an automatic optimization procedure. A further development which includes the detail of the tread pattern in the segment as input to the computer gives closer prediction of higher harmonics of more complex tread patterns.

more restricted because of having to compromise with other properties. Cross texture in a road surface, such as laterally brushed or grooved concrete, was found to increase tire/road noise. Smooth road surfaces emphasized tread pattern noise effects, but this type of surface is now outdated. In the design of the polishing resistant Delugrip Road Surfacing Materials, an attempt at a balance between a surface coarse enough to give adequate bulk water drainage and fine enough to give low noise is found. Recent tests on total traffic noise after resurfacing the Hammersmith fly-over in London have shown almost a 3 dB(A) reduction with Delugrip Road Surfacing Materials compared with the original British Standard Hot Rolled Asphalt. (A discussion and comment appear following the paper.)

by J. C. Walker

Dunlop Ltd., Tire Technical Div., England
 Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise
 Symposium Proceedings," Warrendale, Pa., 1977 p241-50
 Rept. No. SAE-762031; 1977; 13refs
 Availability: In HS-020 811

HS-020 847

PREDICTING TIRE NOISE AND PERFORMANCE INTERACTIONS

A computer program has been developed which predicts tire performance characteristics related to tread design. Handcut tires were tested with specific combinations of three tread design features: the cross slot angle, percent void, and number of cross slots. The test chosen was a three factor, patched orthogonal, central composite design. The tires covered the following range of variables: cross slot angle, 30° - 90° (0° implies circumferential), percent void (surface area of grooves and cross slots divided by total tread area around circumference of tire), 26°-36°; and number of cross slots, 32-96. Remaining tire design variables not included in the study (arc width, number of grooves, width of cross slots, width of grooves) were set comparable to present original equipment radial tires. The tire performance characteristics studied were sound, traction, and hydroplaning. Mathematical equations generated from the test results are used to show that some performance sacrifices may be required to achieve tire noise reductions. When reducing noise levels, the biggest sacrifices occur in 60 mph slide traction (deep water, slippery surface) and hydroplaning. The wet traction rating diminished from 255% better than the control to 160% better than the control and a 15° increase in the tendency to hydroplane resulted while achieving a 3 db sound reduction. In addition, changes made to achieve 50 mph noise reductions increase 34 mph noise levels. Conversely, 60 mph peak wet traction improves as a result of design changes made to reduce 50 mph noise. Some improvement is also achieved in 40 mph slide traction. Attempts to place restrictions on both high and low speed noise levels can have disastrous effects on tire traction. Restriction of 99 dB(A) at 50 mph and 90 dB(A) at 34 mph, arbitrarily placed without considering tire performance, would require severe reductions in 60 mph slide traction. There is a point where small decreases in noise level require large sacrifices in deep water, slippery pavement traction. For example, to achieve a 0.5 dB(A) reduction requires approximately a 16% loss in wet tractive capabilities. (performance levels for optimum combinations within 50 mph noise constraints and GM design restrictions (20°-50° slot angle, 30%-40% void, 48-64 cross slots)). Although not included in this study one cannot

bility, etc. These performance factors must also be considered in any tread design project. (A discussion and comment appear following the paper.)

by L. T. Dorsch
Firestone Tire and Rubber Co.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p251-62
Rept. No. SAE-762032; 1977; 1ref
Availability: In HS-020 811; SAE

HS-020 848

TIRE NOISE REGULATIONS -- TECHNICAL AND ECONOMIC IMPLICATIONS

Operational and design variables affecting tire noise include the following: speed, tread design, road surface, tread wear, load, and tire dimensions. A cost scenario of current tire use practices and revisions to these practices which may be necessary to comply with future noise regulations is presented, and an evaluation of the safety (i.e. traction) implications of various alternatives to meeting these regulations is provided. Significant reductions in community noise levels near highways can be achieved by simultaneously controlling vehicle engine noise and tire noise. Although at present no more than superficial understanding of the mechanisms of tire noise generation exists, truck tire noise regulations can be written utilizing current tire technology without adversely impacting fleet operators or tire manufacturers (if adequate change-over lead time is provided). The data presented herein show that from both a cost and safety point of view, the use of quieter tires provides at least equal, and, in general, advantageous performance when compared to current tire use practices. Information on a tire wear/noise study and for six tire use/cost scenarios are appended. (A discussion appears following the appendices.)

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Department of Transportation, Washington, D.C. 20590
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p265-80
Rept. No. SAE-762033; 1977; 19refs
Availability: In HS-020 811; SAE

HS-020 849

TEST PROCEDURES FOR FUTURE TIRE NOISE REGULATIONS

Two questions relevant to the development of noise emission standards for truck tires concern the appropriateness of SAE J57a recommendations for adjusting load and/or inflation pressure, and the necessity to establish compliance for all tire sizes for tires with similar carcass construction and tread design. Based on the limited set of data presented, either the load/tire inflation pressure recommendations of SAE J57a or the more convenient alternative of maintaining the tire inflation pressure constant at the maximum rated value with reduced loading can be used provided the loads are greater than 70%-75% of the maximum rated tire load. Compliance testing using a single tire size is feasible since sound level variations with size for tires with similar carcass construction and tread design are small (approximately 1.3 dB or less varia-

tion in sound level with tire size for four groups of tires tested (excluding the L78 snow)).

by Roger D. Kilmer
National Bureau of Standards, Washington, D.C.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p281-6
Rept. No. SAE-762034; 1977; 10refs
Availability: In HS-020 811; SAE

HS-020 851

NOISE REGULATIONS -- IMPACTS AND RESTRAINTS

The pass-by techniques for measuring the sound levels of tires accurately and independently as a separate entity are not sufficiently developed to give meaningful and repeatable data. A laboratory method to measure this property free from the complicating influences of road surface, tire wear, speed, weather, etc. is desirable if the test can be made to correlate with highway experience. Laboratory tests are now under development that hopefully will provide the meaningful, repeatable results desired in the near future. Tire noise regulations should be deferred until suitable test procedures are developed; such regulations must be uniform throughout the country. It is impossible for a mass-produced product to comply with differing local regulations each of which has its own diverse regulatory requirements. Existing safety and performance regulations must be considered when promulgating new noise regulations. Such considerations must take standards such as FMVSS 105, 109, 110, 119, 120, 121 under advisement. Above all, consumer safety must not be sacrificed. Finally, the cost of a regulation to the manufacturer and the consumer must be weighted against the benefits. (A discussion appears following the paper.)

by Leo M. Cyr
Rubber Mfrs. Assoc.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p297-302
Rept. No. SAE-762036; 1977
Availability: In HS-020 811; SAE

HS-020 852

EMPIRICAL MODEL FOR PREDICTING IN-SERVICE TRUCK TIRE NOISE LEVELS

An empirical model for predicting in-service truck tire noise levels utilizes the certification test results of SAE Recommended Practice J57a, which specifies a simple, practical noise certification test procedure for tires which results in a single-number rating for maximum A-weighted sound level of the coast-by sound level measured according to prescribed procedures. The usefulness and expected accuracy of the predictive model are shown through a comparison of measured versus predicted maximum A-weighted sound levels for a variety of truck/tire combinations. Since both the average deviation and the standard deviation are less than 1 dB, it is concluded that the model gives accurate estimates of the maximum A-weighted sound level of complex arrays. Before further refinements can be made, more information on the ef-

fect of load is required. (A discussion and comment appear following the paper.)

by D. M. Corley
National Bureau of Standards, Washington, D.C.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p303-9
Rept. No. SAE-762037; 1977; 8refs
Availability: In HS-020 811; SAE

HS-023 850

THE ENVIRONMENTAL, COMMERCIAL AND REGULATORY IMPLICATIONS OF SAE RECOMMENDED PRACTICE J57a FOR TRUCK TIRE SOUND LEVELS

The primary objectives of the SAE Recommended Practice J57a for truck tire sound levels testing scheme were generally agreed to be the following: provide a measure that could be used to compare tire designs for reductions in community annoyance, assure that a well defined procedure existed so that new tires could be developed against a fixed target, establish a consistent standard that would produce the same rating for all test establishments (competitive manufacturers and regulator agencies), and maintain the lowest practical level of cost and technological complexity so as to avoid excluding the agencies and tire manufacturers who could not participate with elaborate testing facilities. Ever since the early proposals leading to the J57a test procedure, tests employing the essential features have been run extensively. The experience gained has uncovered some lack of reproducibility of the measured values both in repeats over long periods with the same test course and equipment, and among different facilities. The following areas are likely to differ among test facilities and, therefore, stand out as likely sources for the variations in test results: sound-inducing tire vibrations, excited by the minor irregularities of the road surface; friction properties of the tire/road interface which affect the sound-generating stick-slip vibrations of a rolling tire and the influence of texture, composition, humidity, contamination, and temperature on the friction; air turbulence due to the vehicle's motion interacting with thermal gradients in the air causing sound refraction and distortion of the radiation patterns of the tires; details of the vehicle's acceleration along with minor variations in road profile, causing vehicle bounce, which in turn modulates tire sounds and interacts with the dynamic response of the sound-measuring system; the different radiation patterns of the many types of tires loading to peculiarities in the rise and fall of sound level and this too interacting with the dynamic responses of commercial sound-level measuring devices; the fact that different models of sound-level meters or sound-level measuring systems may have identical steady-state sensitivities but exhibit significant distinctions in dynamic responses; absorption properties of the road surface or variations in acoustical impedance of the road affecting the transmission of the ground wave; accuracy of speed at pass-by; thermal effects within the tire; and variability in techniques for reading the peak level. With respect to the SAE J57a Recommended Practice in fulfilling the four primary objectives, it is felt that the procedure yields a rough measure that is not yet tied to community annoyance (discrimination of the method not suitable), that the usefulness of the method as a fixed target is precluded by too many uncontrolled variables (climatic conditions greatly reducing the use of SAE J57a for new tire development), that the

larger manufacturing firms with respect to cost but the investments and operating costs are considerable. All factors considered, it appears that a new testing procedure is needed for the emerging requirements of the nation. (A discussion appears following the paper.)

by S. A. Lippmann
Uniroyal Tire Co.
Publ: HS-020 811 (SAE-P-70), "SAE Highway Tire Noise Symposium Proceedings," Warrendale, Pa., 1977 p287-95
Rept. No. SAE-762035; 1977; 1ref
Availability: In HS-020 811; SAE

HS-802 108

ELECTROMAGNETIC INTERFERENCE EFFECTS ON MOTOR VEHICLE ELECTRONIC CONTROL AND SAFETY DEVICES. VOL. 2 - MEASUREMENTS, ANALYSIS AND TESTING. FINAL REPORT

The electrical environment of a motor vehicle during normal operating conditions is evaluated, and a summary is given of power supply variations and electrical signal transient characteristics. Both source and coupled signals were measured. Data and pictures are presented on waveforms associated with the light switch, air conditioner clutch, the starter, the ignition system, flashers, fan and windshield wiper motors, the alternator, and the horn. With each switching (energizing or de-energizing) of equipment from the power bus, there is nominally a 12V dc level change. Transients are sometimes associated with these switching actions which range from 1 V to greater than 100 V in amplitude. The larger transients are generally associated with the de-energizing of inductive loads. Sinusoidal or repetitive waveforms are associated with the motors and vibrators. Their fundamental frequencies are generally below 1 kHz, and their amplitude varied from 0.1 V to more than 3 V. The coupled signals generally appear as exponentially decaying "spikes" and/or as decaying sinusoids. The amplitude and duration of these waveforms are highly dependent on circuit loading and resonance. Typical recorded values range from less than 50 mV to greater than 1 V. Results are given of the use of a computerized coupling analysis program to determine the effects of body shielding, aperture size, and cable lengths on signal coupling in the 100 to 200 MHz band between a simulated mobile radio emission and a modeled air-cushion restraint system cable as it might be used in a motor vehicle. The body shielding depends primarily on the relative positions of the transmitting source and the aperture. The amount of body metal in the direct path between these locations will yield some signal attenuation due to shielding. The cable shielding varies to a small degree as a function of frequency. As much as 30 dB variation in received signal level was observed for the 100 to 200 MHz band, resulting from a fixed aperture size. Also, there was an approximately 10 dB increase in received signal when the length of aperture was increased from four to 40 inches. Finally, results of a series of susceptibility tests were performed on an electronic speed control system and an antisick control module to determine functional upset levels of injected signals at critical circuit ports on these devices. The upset criteria were based on performance departures from normal, resulting from the injection of interfering signals. The injected signals were designed to represent levels and durations characteristic of those generated within the vehicle or coupled from external sources. Signal characteristics are shown to depend on circuit susceptibility, namely frequency,

speed control sensor compared to an opposite situation for the antiskid module; the sensitivity of the speed control sensor input to dc pulse amplitudes of approximately one-half the sensor peak-to-peak amplitude; and the similarity of results observed between rf pulse signals and cw signals at the antiskid sensor inputs, indicating that this circuit is primarily sensitive to rf signals.

by R. H. Espeland; D. H. Layton; B. D. Warner; L. R. Teters
Department of Commerce, Inst. for Telecommunication
Sciences, Boulder, Colo. 80302
Contract DOT-HS-5-01097
1976; 141p 11refs
Rept. for 1 Mar 1975-1 Jul 1976. Vol. 3 (Automotive EMC
Guidelines) is HS-802 109.
Availability: NTIS

HS-802 109

ELECTROMAGNETIC INTERFERENCE EFFECTS ON MOTOR VEHICLE ELECTRONIC CONTROL AND SAFETY DEVICES. VOL. 3 - AUTOMOTIVE EMC GUIDELINES. FINAL REPORT

Basic guidelines are given that will serve to emphasize and highlight those factors in the use of electronics for automotive safety and control that are important to the accomplishment of electromagnetic compatibility (EMC) among the various subsystems. Preliminary to the presentation of the guidelines are discussions of the applications and technological developments concerned with current automotive electronics, of research conducted by the automotive industry to explore the feasibility of a central processor or control system and potential problem areas, and of the automotive electrical environment (source signal waveforms, coupled signal waveforms, chassis DC resistance measurements, power supply characteristics and severe transients, normal noise levels, external sources). Guidelines for design are discussed in the following sections: device sensitivities and noise immunity, technological development (operational amplifiers, improved encapsulation, displays, microprocessors, power devices, sensors and transducers), and design practices (component and circuit design, modular design, use of proven devices and techniques). Guidelines for installation concern the following: shielding techniques, shielding practices, grounding and bonding (single-point grounding, multi-point grounding, bonding), grounding and bonding practices, wiring and transmission lines (wiring classes, cable and wiring installation), wiring and cabling practices, filtering and cabling practices, filtering and suppression techniques, specific interference source reduction techniques, and filtering and suppression practices. Guidelines for testing concern the following: testing techniques, models for analysis and evaluation, subsystem evaluation, and vehicle testing.

by R. H. Espeland; E. L. Morrison, Jr.
Department of Commerce, Inst. for Telecommunication
Sciences, Boulder, Colo. 80302
Contract DOT-HS-5-01097
1976; 91p 26refs
Rept. for 1 Mar 1975-1 Jul 1976. Vol. 2 (Measurements,
Analysis and Testing) is HS-802 108.
Availability: NTIS

HS-802 257

MOTORCYCLE BRAKING PERFORMANCE. SUMMARY TECHNICAL REPORT. VOL. 1

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Contract DOT-HS-5-01264
Rept. No. UM-HSRI-76-30-1; 1977; 22p
Rept. for Jul 1975-Oct 1976. Vol. 2 (Final Technical Report) is
HS-802 258; Vol. 3 (Appendices) is HS-802 259. For abstract
see HS-802 258.
Availability: NTIS

HS-802 258

MOTORCYCLE BRAKING PERFORMANCE. FINAL TECHNICAL REPORT. VOL. 2

The existing Federal Motor Vehicle Safety Standard for Motorcycle Braking Systems (FMVSS 122) is evaluated and an alternate test methodology is developed which resolves certain shortcomings in that standard. The new test methodology has the following two basic features: towing of test motorcycle by a support vehicle at constant velocity for all of its dynamic performance measurements, and conducting of all tests with braking control effort being applied to only one actuator at a time. The developed methodology has been found adaptable to advanced motorcycle braking systems such as may be anticipated within the next ten years of evolution in the motorcycle market. This technique is recommended for development into a next-generation motorcycle braking standard. There is a lack of a sound basis for specifying the modulability of the brake system (i.e. that quality which permits a typical rider to accrue the vehicle's innate stopping capability without suffering wheel lockup and the attendant loss of control). Accordingly, research should be conducted to establish the grounds for a motorcycle brake system modulability requirement. Requirement levels concerning limit stopping capability may have to be adjusted for compatibility with an eventual modulability specification. The safe braking of motorcycles depends as much, or more, upon the rider's ability to interact with the machine properly as it does upon the machine's physical limitations in braking capability.

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Contract DOT-HS-5-01264
Rept. No. UM-HSRI-76-30-2; 1977; 119p 5refs
Rept. for Jul 1975-Oct 1976. Vol. 1 (Summary Technical
Report) is HS-802 257; Vol. 3 (Appendices) is HS-802 259.
Availability: NTIS

HS-802 259

MOTORCYCLE BRAKING PERFORMANCE. APPENDICES A, B, C, D, E, F. VOL. 3

Appendices are presented for a report on a study to evaluate the existing Federal Motor Vehicle Safety Standard for Motorcycle Braking Systems (FMVSS 122) and to develop an al-

Kawasaki F9C and Harley-Davidson FXE-1200 demonstration tow-test data, description of tow-test hardware, comments of motorcycle manufacturers concerning evolution of brake technology, analytic development of the tow-test concept, and combined slip traction data of motorcycle tires.

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Contract DOT-HS-5-01264
Rept. No. UM-HSRI-76-30-3; 1977; 426p
Rept. for Jul 1975-Oct 1976. Vol. 1 (Summary Technical Report) is HS-802 257; Vol. 2 (Final Technical Report) is HS-802 258.
Availability: NTIS

HS-802 260

FY 1977 IMPLEMENTATION OF THE NATIONAL ACCIDENT SAMPLING SYSTEM

Actions planned in fiscal year 1977 in the National Center for Statistics and Analysis (NCSA) are directed at the implementation of the National Accident Sampling System (NASS) which collects representative data on a large number of accidents and is intended to become the standing network and methodology for the collection of accident research data required to support standards and countermeasure evaluation. The system when completed will be a probability sample of approximately 18,000 accidents annually which have been investigated by accident investigation technicians. The accidents will include those involving passenger vehicles, trucks, motorcycles, bicycles and pedestrians. The integration of on-going programs (Special In-Depth Accident Investigation, National Crash Severity Study, Accident Causation Study, FMVSS 121 Evaluation, Pedestrian Accident Study, Methodology Studies) into the NASS framework is discussed. The existing data collection network has two important weaknesses, one being that it allows trained teams to stand idle and lose capability during periods of inactivity, the other being the absence of adequate definition and representativeness of the universe from which data are collected. A general or macroview of the implementation plan for NASS addresses the following tasks: a schedule for selection of sites and procurement of teams in a series of expansions, a performance review and evaluation of any selected accident research teams, and a schedule for the completion or continuation of existing efforts and their dissolution or integration into NASS. The implementation of NASS when viewed on a detailed or microscale includes the following four general phases: completion of initial system, design and initiation of National Crash Severity Study (NCSS); operation and evaluation of NCSS; initiation and pilot testing of the continuous sampling subsystem of NASS; and transition to the full operation of NASS.

by Russell A. Smith; James C. Fell; Charles J. Kahane
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Rept. No. TR-N43-30; 1977; 42p Srefs
Availability: NTIS

CAUSATION. VOL. 1. TECHNICAL REPORT AND APPENDIX A

Vehicle size seems to correlate with accident experience; there are also correlations between vehicle track width and rollover accidents, driver age and size of car, size of car and accidents on curves, and driver age and accidents on curves. Hypotheses are developed linking vehicle handling characteristics to accident descriptors. Careful consideration is then given towards developing a statistical analysis method to support or negate such hypotheses and further define the amount of data required to support a given hypothesis. Implementation of the methodology to investigate the role of vehicle handling, as proposed, requires that the following four kinds of data be collected: exposure-to-risk data, accident data, vehicle handling descriptors, and "image risk" (vehicle characteristics which project a particular image to its driver, e.g. "sporty," "macho," "sedate") data. The requirement for each of these data categories is discussed at length. In addition to defining an accident data collection and analysis methodology, efforts were also devoted towards advancing the present state of the art in reconstructing the pre-crash phase of accidents and towards outlining a deterministic analysis procedure for relating vehicle handling performance directly to accident avoidance performance. The conclusions emphasize the formidable and costly nature of implementing the proposed methodology, but point out that by dovetailing efforts with other areas (of concern to accident causation analysis), agencies could substantially increase the benefit/cost ratio of follow-on research and implementation. An appendix provides a supplemental literature review which encompasses the role of vehicle handling in accident causation as it relates to vehicle performance factors, the vehicle/driver interface, and the vehicle/roadway interface.

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Contract DOT-HS-4-00942
Rept. No. UM-HSRI-76-12-2; 1977; 264p 128refs
Rept. for Jun 1974-Apr 1976. Vol. 2 (Appendices B, C, D, E) is HS-802 262.
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HS-802 262

A METHODOLOGY FOR DETERMINING THE ROLE OF VEHICLE HANDLING IN ACCIDENT CAUSATION. VOL. 2. APPENDICES B, C, D, E

Appendices for a report on the development of a methodology for determining the role of vehicle handling in accident causation are presented and provide the following information: analysis of mass accident data for vehicle handling causative factors (detailed tables and figures of mass accident data from King County (Seattle) Wash., and from Texas with discussions of specific findings); indirect standardization, an example (application of the methodology to existing data from corresponding accident and exposure files from the Hwy. Safety Res. Inst.); supplemental accident report form for vehicle handling (developed for gathering information which could be used to identify vehicle handling factors in an accident and divided into sections which encompass environment, roadway, vehicle, operator and accident kinematics); and supplemental data on relationships between vehicle handling parameters (and indices) and accident descriptors (plots of vehicle han-

HS-802 261

A METHODOLOGY FOR DETERMINING THE ROLE OF VEHICLE HANDLING IN ACCIDENT

ding parameter and index values as a function of accident frequencies).

by D. F. Dunlap; L. Segel; F. L. Preston; P. Cooley; B. C. Brown
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Contract DOT-HS-4-00942
Rept. No. UM-HSRI-76-12-3; 1977; 251p
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Appendix A) is HS-802 261.
Availability: NTIS

HS-802 264

ON-THE-ROAD DRIVING BEHAVIOR AND BREATH ALCOHOL CONCENTRATION. FINAL REPORT

With the longer range goal of reducing alcohol-involved crashes on the highways by providing means of improving early on-road detection and intervention with regard to high risk, high BAC (breath alcohol concentration) drivers, an unobtrusive means of detecting drivers with high BAC while they are actually using the highways was devised and tested. Unobtrusive measures of nocturnal driving performance were obtained on public highways at 42 rural sites on Thursday, Friday, and Saturday nights from approximately 10:30 P.M. to 3:00 A.M. Special data acquisition and recording systems were developed to obtain analog records of speed and lateral position electronically. The roadside survey team was located approximately one mile downstream from the observation window. An analog record of speed was also obtained near the survey site as drivers were directed to a stop by a law enforcement officer. The survey team obtained BAC measures from 1,663 motorists, as well as interview data concerning biographical variables, drinking patterns, and driving record. BAC's of 0.10 or higher were found in 4.6% of this 100% sample of the nocturnal weekend driving population. Interview results confirmed that young male motorists are an important population-at-risk, but older male and female liquor drinkers are also prevalent. A double standard exists regarding attitudes toward beer and liquor, especially among younger males. Driving performance measures indicated that drivers with 0.08-0.149 BAC react with caution to unexpected situations, but are less able to smoothly come to a stop when directed to do so. Legal constraints which affected field activities are discussed and include the fact that all vehicles passing through the point of the roadside research survey had to be stopped and had to be checked for defective equipment (thus resulting in a much larger sample than initially planned for); that any manipulated intervention situations that might cause the motorist to over-react could not be utilized (filming or videotaping in-car behavior not permitted); that, because of the previous restriction, a very large sample of nonintervention behaviors was obtained rather than a small controlled sample of response to a contrived, but constant intervention situation; and that steps had to be taken to ensure confidentiality of interview information and the official motor vehicle record of an individual could not be compared with self-reported driving record. Measures of differences in the lateral position and movement of vehicles did not indicate any apparent influences of alcohol, and observations for and check ratings of deviant driving behavior in terms of aberrant lateral movement or speed were not successful. Further efforts to measure on-road driving behavior from a stationary roadside site are contraindicated. However, it is conceivable that a mobile data collection method which could be employed over longer distances and longer periods of data collection (e.g. a vehicle mounted radar

system) can lock onto a specific vehicle once it acquires the radar signal) may be useful.

by David K. Damko; S. R. Toussie; Norman R. Akley; Henry A. Geller; David G. Whitmore
Psychological Res. Foundation of Vermont, Inc., P.O. Box
867, Burlington, Vt. 05401
Contract DOT-HS-364-3-757
1977; 223p 70reft
Rept. for 1 Jul 1973-30 Dec 1976.
Availability: NTIS

HS-802 265

YIELDING-BARRIER TEST DATA BASE- REFINEMENT OF DAMAGE DATA TABLES IN THE CRASH PROGRAM. INTERIM REPORT

Refinements to vehicle crush data stored in tables within the CRASH2 (Calspan Reconstruction of Accident Speeds on the Highway 2) program, prior to the application runs, are summarized. A special computer program, CRUSH, was developed to aid in the performance of this research. Significant improvements were made in the empirical crush coefficients stored in the CRASH2 computer program for frontal and side collisions. The CRUSH program, which may be viewed as an inversion of the damage analysis portion of CRASH2, is found to be an attractive concept for further development to extract empirical crush coefficients, either for the present simple linear relationships or for more refined future nonlinear relationships, from a wide variety of staged collisions. In its present form, the CRUSH program is cumbersome to apply to multiple data points. The assumed simple linear relationships in the damage analysis portion of CRASH2 have been shown to yield good approximations of speed changes for a variety of collision configurations and vehicle-category combinations. They appear to be somewhat less appropriate for the small vehicle categories which experience a large range of speed changes in mixed-vehicle collisions. The damage that occurs in side collisions is more variable than that in end collisions as a result of the presence of the A and B pillars, sills and wheels, which produce a greater sensitivity to detailed dimensions of the impact configuration. An application of different crush coefficients in several damage "zones" on the sides of each vehicle category may be found to be beneficial in future refinements of the CRASH2 damage analysis routine. The CRUSH computer program should be extended to incorporate the following features: permanent storage of the results of all processed staged collisions, and a routine for automatically fitting several forms of analytical relationships (e.g. linear, bilinear, polynomial) to multiple data points. These extensions would overcome present operational difficulties that are encountered in dealing with only two cases at a time, and would permit periodic updates of empirical fits for the individual vehicle categories as the staged collision data bank becomes more extensive.

by Raymond R. McHenry
Calspan Corp., 4455 Genesee St., Buffalo, N.Y. 14221
Contract DOT-HS-6-01372
Rept. No. CC-ZR-5954-V-1; 1977; 57p 20reft
Rept. for May-Dec 1976.
Availability: NTIS

HS-802 266

CAUSATIVE FACTORS AND COUNTERMEASURES FOR RURAL AND SUBURBAN PEDESTRIAN ACCIDENTS: ACCIDENT DATA COLLECTION AND ANALYSIS. FINAL REPORT

Data on rural pedestrian accidents were collected and analyzed to identify potential countermeasures directly relevant to the accident situation. Data on a stratified random sample of over 1,500 rural and suburban accidents from six states (California, Michigan, Missouri, North Carolina, Pennsylvania, Texas) were collected during interviews and on-site observations. These data included behavioral sequence items (preinvolvement and collision course factors; evasive action factors; pedestrian, driver, and environmental causal factors), site characteristics items (areas and roadway description, roadway geometry, traffic control devices, observed vehicle speeds, sight distance, site photographs), and exposure data items (vehicle, pedestrian, driver, and environmental factors) directed at identifying the precipitating and predisposing causal factors in each accident. The data analysis emphasized the development of characteristic accident situations or "accident types" from groups of behaviorally similar accidents. Although 23 accident types were identified, the six most frequently encountered types accounted for over 60% of the sample. They are as follows: walking along the roadway, 11.6% (pedestrian struck while walking along the edge of the roadway or on the shoulder, walking either with or against traffic); dart-out, first half, 10.8% (not at an intersection, pedestrian suddenly in front of the vehicle and struck in the first half of the roadway); dart-out, second half, 10.3% (same as preceding type, except pedestrian struck in the second half of the roadway); midblock dash, 9.9% (not at an intersection, pedestrian running into roadway, but not appearing suddenly in the path of the vehicle); intersection dash, 9.9% (at an intersection, pedestrian either running or appearing suddenly in the path of the vehicle); and other, 9.5% (involves unusual accident situations that are not included in the other causal types; although unusual they are generally countermeasure-corrective, at least on an individual basis). Countermeasure concepts based on the primary causal characteristic of the particular accident type which pinpoint the basic characteristic(s) of the accident type that must be eliminated or modified if the occurrence of the specific accident type is to be reduced are discussed for each accident type. Also, potential countermeasures that include ways to achieve the effect as described by the countermeasure concept are given for each accident type.

by Richard L. Knoblauch
Biotechnology, Inc., 3027 Rosemary Lane, Falls Church, Va.
22042
Contract DOT-HS-355-3-718
1977; 265p
Rept. for Jul 1973-Mar 1976.
Availability: NTIS

HS-802 274

SLED TESTS OF THE AIR BAG - CRUSHABLE DASH-KNEEBAR PASSIVE RESTRAINT IN THE VOLVO 244. FINAL REPORT

Evaluation tests were conducted of the Air Bag - Crushable Dash-Kneebare Passive Restraint system in the interior environment of a Volvo 244 automobile. In a sled test program, the restraint system was evaluated at velocities between 30 mph

position. One run was conducted at 30 mph for the forward position six-year child size dummy. All tests were frontal impact simulations. The restraint system as set up in the Volvo 244 interior would provide protection to a 50th percentile male size occupant in a frontal crash up to approximately 45 mph, the seat in the mid-position (for rear seat position, crash velocity at which protection would be provided would be considerably less). It appears difficult to fault the force level of the collapsible dash of nominally 2600 lbs dynamically or 2000 lbs statically, as this level does produce chest accelerations in the low 40 g range when stroking properly. However, the stroke length available for the dash is marginal at 45 mph. Small changes in interior geometry, such as seat position or knee bar clearance, can easily affect whether or not the column length is adequate. Another factor of major concern is the system's tendency to produce rapid changes in chest acceleration. Sensitivity to bag penetration by the chest could be reduced or eliminated by having the bag deploy from the front of the manifold. This, with a corresponding forward placement of the manifold, would have the additional benefit of decreasing the encroachment of the system into the occupant compartment.

by David J. Romeo
Calspan Corp., 4455 Genesee St., Buffalo, N.Y. 14221
Contract DOT-HS-4-00972
Rept. No. CC-ZM-5566-V-3; 1977; 36p 4refs
Rept. for Jan-Dec 1976.
Availability: NTIS

HS-802 284

FUEL ECONOMY IMPROVEMENT THROUGH DIAGNOSTIC INSPECTION

In conjunction with conducting a Motor Vehicle Diagnostic Inspection Demonstration Project in Arizona, the fuel economy benefits of an exhaust emissions inspection and maintenance system were determined. Fuel economy sample cars were sufficiently alike to afford a statistical confidence of over 99% in the conclusions. The trade-off between confidence level and variety of makes and models was resolved in favor of high confidence by restricting the sample to two homogeneous groups of 1969-1972 model compact and intermediate size passenger cars that had failed a periodic emission inspection. Standard Environmental Protection Agency (EPA) fuel economy tests were made on each car before and after minimum cost emission repairs. The average consumer benefit was found to be up to 5.3% more miles per gallon. Five interesting cases of specific vehicles used in the study are described. Periodic emission inspection, diagnosis and maintenance on rejected cars can be administered with low cost to the motoring public. Periodic inspection does reduce exhaust pollution levels of hydrocarbons (HC) and carbon monoxide (CO). This type of inspection significantly improves fuel economy for cars of the makes and model years tested.

by Ted Bayler; Leslie Eder
National Hwy. Traffic Safety Administration, Office of State Vehicle Progs., Washington, D.C. 20590
1977; 15p 1ref
Availability: NTIS

RESTRAINT SYSTEMS EVALUATION PROJECT CODEBOOK

The codebook is for use with the data in the Restraint Systems Evaluation Project (RSEP) file, which consists of approximately 21,000 cases of accident-involved occupants of 1973-1975 model year passenger cars. The data obtained from this study were basic accident, vehicle, and occupant information; occupant restraint system usage; vehicle damage descriptions; and occupant injury descriptions. The RSEP data have been automated as three system files to be used with the Statistical Package for the Social Sciences (SPSS). The files are stored on magnetic tape and reside at the COMNET Corporation, 5185 MacArthur Blvd., Washington, D.C. 20016. COMNET is a Government Time-Sharing Vendor and has IBM 360 computers with OS system. Extensive appendices provide the following information: univariate distributions and histograms for Barrier Equivalent Velocity (BEV) and energy equivalent velocity; occupant restraint system summary form hard copy (used in accident investigation); occupant restraint systems summary form (coding instructions)-hard copy (accident location codes, make/model codes, vehicles/objects contacted, occupant injury classification); and excerpts from "A Program to Evaluate Active Restraint System Effectiveness" (reprinted from "Proceedings, Fourth International Congress on Automotive Safety," GPO, 1975).

by Jeanie S. Mungenast; Charles J. Kahane
National Hwy. Traffic Safety Administration, National Center
for Statistics and Analysis, Washington, D.C. 20590
Rept. No. NHTSA-TN-N43-32-2; 1977; 162p 59fms
Availability: NTIS

HS-802 286

RESTRAINT SYSTEMS EVALUATION PROGRAM. FINAL REPORT

In conjunction with NHTSA's Restraint Systems Evaluation Program (RSEP), investigations were carried out by a team assigned to the nine western states of California, Nevada, Arizona, Utah, Oregon, Washington, Montana, Wyoming, and Idaho. Level II investigations included random selection of police-reported accidents and a limited follow-up investigation of the human and vehicular components of the accidents. Level III investigations included intensified follow-ups of all aspects of collision events, i.e. human, vehicle, and environment factors, as well as determination of Abbreviated Injury Scale (AIS), Occupant Injury Classification (OIC), Collision Deformation Classification (CDC), Simulated Model of Automobile Collision (SMAC), and Calspan Reconstruction of Accident Speeds on the Highway (CRASH). During the study, 2,853 accidents were investigated using the Level II technique; an additional 29 collisions were studied under the Level III technique. Four of the 29 collisions involved vehicles equipped with the ACRS, two occurring in California, one in Washington, and one in Wyoming. Three of the four ACRS cases involved ACRS deployment that functioned within design limits. The remaining 25 Level III cases and all Level II investigations were conducted in the cities of Los Angeles and Culver City, Calif. The Level II investigations revealed that 43% of the occupants of the vehicles studied utilized the restraint systems (lap and torso belts) available. Approximately 46% of

the drivers and 36% of the right-front passengers utilized the available restraints.

by J. Baird; F. Sublett; R. Hughes; J. Didion; J. Stoddard; D. Wheatley; V. Averett; D. Clark; J. Zapian
University of Southern California, Inst. of Safety and Systems
Management, Los Angeles, Calif. 90007
Contract DOT-HS-010-1-176
Rept. No. USC-75; 1977; 271p 11fms
Rept. for Jun 1974-Jan 1976.
Availability: NTIS

HS-802 287

MATHEMATICAL RECONSTRUCTION OF HIGHWAY ACCIDENTS-FURTHER EXTENSIONS AND REFINEMENTS OF THE CRASH COMPUTER PROGRAM. FINAL REPORT

The analytical bases and the computer aspects of modifications incorporated into the Calspan Reconstruction of Accident Speeds on the Highway-2 (CRASH2) computer program are documented. The program was modified in the following respects: to incorporate an optional trajectory simulation routine, based on the corresponding portion of the Simulation Model of Automobile Collisions (SMAC) computer program; to permit automatic testing and refinement of the CRASH estimation of separation velocities; to provide an optional abbreviated format for the time-sharing version of CRASH; to provide an optional batch mode of operation; and to revise and extend the output format. The following recommendations are also presented: "build in" and make automatic to the greatest possible extent analytical refinements and extensions, incorporate provisions for inclusion of the effects of under-ride/override on the interpretation of vehicle crash dimensions, prepare simple approximation techniques and corresponding user questions related to common complicating factors (e.g. secondary collisions, terrain features, rollovers) for future incorporation in the CRASH program, extend RERUN option to include automatic presentation of questions affected by a change in a YES or NO response, incorporate additional logic in the error calculations within the trajectory simulation option to permit user entry of either positive or negative heading angles, and incorporate an additional internal check of user inputs in CRASH2 to verify that the specified spinout dimensions and conditions are compatible with a common velocity at the damage centroids.

by Raymond R. McHenry; James P. Lynch
Calspan Corp., 4455 Genesee St., Buffalo, N.Y. 14221
Contract DOT-HS-5-01124
Rept. No. CC-CO-5708-V-5; 1977; 39p 2fms
Rept. for Feb-Nov 1976.
Availability: NTIS

HS-802 288

TOWARDS A LOW COST HIGHLY RELIABLE ANTI- LOCK BRAKE SYSTEM FOR SMALL MOTORCYCLES. FINAL REPORT

An approach to anti-lock braking for motorcycles utilizes the rate of change of angular acceleration as a feedback signature. The front wheel braking system of a motorcycle has been modeled using computers. This modeling describes the tire as an elastic member of the braking system. The analytical model points out the advantages gained from use of the rate of

change of angular acceleration (jerk) as a feedback signature: repeatability in indicating the maximum stopping force, no system compromising requirement to account for varying road conditions, large magnitude, and simplicity of the proposed control system. In addition, the front wheel and brake from a Kawasaki KZ-400 were placed on a drum dynamometer for study. Results substantiate the predictions of the model showing the proper change in slope of wheel angular acceleration. The technology of fluidics is suggested for implementation of the system concept. Two accelerometer concepts are discussed as well as the required circuitry and actuator. The toroidal accelerometer appears to be the most desirable. This is a very new concept and needs immediate further study to determine its capabilities. The mass-fluid resistive device is not the first choice, but it offers system advantages (impedance matching) which may prove desirable. Future work should also concentrate on a brake pressure modulator. The fluidically augmented caliper should be studied for its capabilities and integration with the vehicle. This device offers fast response while maintaining cost as low as possible. The use of solenoid bleed valves may also be studied as an alternative since they offer simplicity and low cost, although their system integration is not as obvious. Once selection of the sensor and actuator has been made, a complete study of the control system would be desirable. This could be performed on a drum dynamometer initially to allow full instrumentation while studying the performance of the control philosophy. Following this, the system could be installed on a test vehicle for full system study. At this time the system believed to be most suitable would include the toroidal accelerometer, fluidic control system and the fluidically augmented caliper actuator.

by Stephen M. Tenney
Harry Diamond Lab., 2800 Powder Mill Rd., Adelphi, Md.
20783
DOT-HS-5-01133
1977; 58p 2refs
Rept. for 1 Jul 1975-30 Jun 1976.
Availability: NTIS

HS-802 289

FIELD STUDY OF DRIVER VISUAL PERFORMANCE DURING RAINFALL. FINAL REPORT

Field studies of driver visual performance during rainfall included determination of the degradation of static visual acuity in terms of visual angle, detection probability, and legibility as a function of rain intensity. Experiments performed included a field study during actual rain conditions, a simulator study using artificially produced rain, a film study using photographic techniques for the determination of visual degradation during simulated rain, and a free-way surveillance study to investigate driver behavior. It was found that water on the windshield is the primary factor accounting for reduced visibility. Visual degradation (day) with windshield wipers operating seems to be a linear function of rain rate with normally encountered drop sizes. During night conditions, drop size is a significant factor in reducing visibility (smaller drops being a more serious problem than rain rate). The passenger side wiper has a severe obscuring effect on driver side viewing area at high rain rates. Wiper speeds above 45 cpm (cycles per minute) did not improve visibility (probably the result of the obscuring effect of the passenger side wiper). Without windshield wipers visibility is reduced to unacceptable levels for driving (equivalent to greater than 20/200) in less than one second at rain rates greater than one inch per hour effective.

visual degradation, effective rain rate can be determined from vehicle velocity, drop terminal velocity, windshield rake angle, and actual rain rate. Further areas that require investigation include the effect of hardware configuration, defects, pitting, and road film and the effect of lighting configurations. In addition, the rain simulator is a practical tool for the evaluation of hardware configurations and the vehicle occupant interface during rain conditions, and the simulator must be calibrated to human behavior before it can be effectively used for hardware evaluation or research.

by R. S. Morris; J. M. Mounce; J. W. Button; N. E. Walton
Texas Transportation Inst., Texas A and M Univ., College Station, Tex. 77801
DOT-HS-5-01172
1977; 182p 10refs
Rept. for Jun 1975-Nov 1976.
Availability: NTIS

HS-802 290

SYSTEMS ANALYSIS OF THE VISIBILITY REQUIREMENTS OF PASSENGER CAR DRIVERS. FINAL TECHNICAL REPORT

A study was conducted to review, critique and integrate previously developed models of passenger car driver field-of-view (FOV) requirements, and to develop and demonstrate a methodology for deriving visual requirements of such drivers. The latter task included FOV requirements and relevant target characteristics. Previous FOV models, although useful and informative were found to be overly simplified and inadequate for purposes of generating design specifications for automobile visibility systems. The methodology used to derive FOV requirements involved the construction of scenarios for five specific driving situations (freeway/lane changing, highway/passing, suburban/backing, urban/intersection, highway/merge) and their subsequent analyses. The scenarios were developed by considering driving mode, situation, driver tasks (perceptual and cognitive), and accident and collision avoidance investigations. A composite FOV of the five scenarios was made and compared with composite FOV's developed in previous studies. Considerable discrepancies were observed and discussed. However, all studies were in agreement that, in considering all driving situations, a 360° FOV is required to observe all relevant targets. Conclusions related to potential visibility systems design and future research include the following: need for future models to consider driver time and error in order to define a usable set of requirements which will eventually permit development of improved systems; need for visual time sharing requirements of the FOV to be determined precisely and quantitatively; need for subareas within the required 360° FOV to be prioritized using analytic methods and validated using empirical data; need for the ultimate role and current utility of peripheral vision to be determined satisfactorily; need for research on driver performance to understand driver visual capability in actual driving situations, and/or in highly realistic driving simulations; and the need for additional performance data to allow extension of the scenario methodology, resulting in more detailed requirements than have been derived to date.

by W. J. Burger; R. L. Smith; J. E. Queen; G. B. Slack
Dunlap and Associates, Inc., Western Div., 115 South Oak St., Inglewood, Calif. 90301
DOT-HS-5-01202
1977; 177p 180refs

MULTIDISCIPLINARY ACCIDENT INVESTIGATION DATA FILE. 1975. FINAL REPORT

Work done by the Highway Safety Research Institute (HSRI) between Apr 1975 and Apr 1976 in editing and processing in-depth accident reports generated by Multidisciplinary Accident Investigation (MDAI) teams under the National Highway Traffic Safety Administration is reported. During this period, accident investigation case studies were edited and formatted into the HSRI-maintained CPIR (Collision Performance and Injury Report) Revision 3 data sets. In addition, new data sets implemented from the Damage Analysis Supplement, Occupant Supplement, and Air Cushion Restraint System (ACRS) supplement have been created. The production aspects of the program, the data editing and quality control protocol used in case editing, and the contents of the data files that are constructed from the CPIR, Revision 3 and the ACRS supplements are described. An index of DOT-HS publication numbers and team cases is also included.

by Joseph C. Marsh, 4th; Marion J. Compton; John A. Green
Highway Safety Res. Inst., Huron Pkwy. and Baxter Rd., Ann Arbor, Mich. 48109
DOT-HS-5-01134
Rept. No. UM-HSRI-76-7; 1977; 79p 10refs
Rept. for 18 Apr 1975-17 Apr 1976.
Availability: NTIS

HS-802 292

DEVELOPMENT OF A TRAINING PROGRAM FOR DRIVER LICENSING ADMINISTRATIVE HEARING OFFICER. FINAL REPORT

A description of the activities involved in materials development, pilot test, and evaluation of a two-day in-service training seminar for the Driver Licensing Administrative Hearing Officer (DLAHO) is presented. The three-volume package includes a "Course Guide," an "Instructor's Manual," and a "Participant's Manual". The DLAHO is defined as the administrative hearing officer authorized to hear and/or adjudicate motor vehicle licensing agency cases where discretionary license actions are taken. Given the positive reactions from the participants and their supervisors at both the developmental and pilot tests (Maryland and North Carolina), it can be concluded that the project was successful in attaining the respective Departments of Motor Vehicles (DMV) recognition of the need for and advisability of the type of training provided. The disparities among state vehicle codes and driver licensing agency policies was found to limit the applicability of the final package, but not as severely as first thought. It is felt that the seminar can easily be adapted for nationwide use. The DLAHO's high acceptance level of the seminar was felt to be directly attributable to the participatory nature of the package. The majority of the 15-20 licensing agencies visited, surveyed, and contacted during the first phase of the project (to determine dominant characteristics of the hearing process and tasks performed by DLAHO's) have expressed further interest in the administration of the package when it is available through the GPO. It is recommended that the package administered only intrastate, i.e. with only the DLAHO's from one agency in attendance; that the guidelines provided in the "Course Guide" should be carefully followed to achieve the most successful seminar conduct; and that the DLAHO seminar be attended by the Chief DLAHO and/or other DMV supervisory personnel since their input will be required if policy changes

Someone from the State Governor's Representative Office would be very desirable for the first morning of the seminar.

by M. W. Nesbitt; D. W. McGill
Applied Science Associates, Inc., Box 158, Valencia, Pa. 16059
DOT-HS-5-01268
1977; 69p 1ref
Rept. for Jul 1975-Dec 1976.
Availability: NTIS

HS-802 293

ALCOHOL EXPERIMENTS ON DRIVING-RELATED BEHAVIOR: A REVIEW OF THE 1974 ALCOHOL COUNTERMEASURES LITERATURE. FINAL REPORT

The literature related to alcohol experiments on driving-related behavior is reviewed by means of a survey of 33 experiments and six review articles published in 1974 concerned with those aspects of behavior assumed to be relevant for successful driving that are actually impaired by alcohol and that consequently appear to increase the likelihood of a crash. The following topics are included in the review: research reviews and references; information processing (nature and locus of alcohol effects, divided attention, short-term memory); arousal, drinking variables, especially acute adaptation to alcohol effects; and recent trends and future priorities in alcohol research. The following four important and continuing trends were noted: greatly increased interest in investigating behavioral as opposed to epidemiologic, aspects of alcohol involvement in highway crashes; increased specificity of research on exact alcohol influences upon key driving-related variables; increased sophistication and rigor of experimental designs, controls, and procedures; and increased Government-sponsored research, with concomitant increases in Federal control of research directions and activities through use of proportionally more problem-oriented contracts as opposed to investigator-initiated grants. The most important single issue concerns alcohol impairment of information processing, both in terms of its nature and exact locus.

by M. W. Perrine
National Safety Council, 444 N. Michigan Ave., Chicago, Ill. 60611
DOT-HS-4-00965
1977; 59p 43refs
Rept. for 1974
Availability: NTIS

HS-802 306

YOUTH AND DRIVING; A SUBJECT BIBLIOGRAPHY FROM HIGHWAY SAFETY LITERATURE

A bibliography concerning youth driving on the nation's highways is derived from literature acquired since the establishment of the National Highway Traffic Safety Administration (NHTSA) in 1967. It is comprised of NHTSA contract reports, reports of other organizations concerned with highway safety, and articles from periodicals in related fields. Citations follow the format used in the monthly abstract journal Highway Safety Literature and are indexed by a key-word-out-of-context (KWOC) listing, author, corporate author, con-

tract number, and report number. Availability is given in individual entries.

by Lois Flynn, comp.
National Hwy. Traffic Safety Administration, Technical Services Div., Washington, D.C. 20590
Rept. No. SB-15; 1977; 155p
Availability: NTIS

HS-802 308

PRELIMINARY ANALYSIS OF LAW ENFORCEMENT COUNTERMEASURES. ANALYTIC STUDY FOR 1973

The Los Angeles County (Calif.) Alcohol Safety Action Project (ASAP) utilized a demonstration area (mini-ASAP) in the county to evaluate its countermeasure activities. The positive effect of ASAP patrols was indicated by accident reduction: 8 P.M. to 8 A.M. fatal crash rates for the area show a decrease from expected values during ASAP's operation. The level of ASAP unit saturation seemed to relate to accident reduction. The primary impact of ASAP law enforcement activities on other countermeasures comes from the increased number of driving under the influence (DUI) offenders entering the total ASAP Traffic Safety System. Although the 1973 Roadside Survey showed significant awareness of ASAP patrols, drinking and driving behavior was unchanged. Total arrests in the mini-ASAP were up 57%, an increase including ASAP direct arrests and indirect arrests due to the catalytic effect of the ASAP on regular patrols. The videotape system with which ASAP patrol cars were outfitted led to increased guilty plea rates, reduction in altercation rates, and possible rehabilitation benefits. Recommendations include: statistical evaluation of the current Pre-Arrest Sobriety Test; a pilot study to test the "dose" relationship of FOI crashes and ASAP Patrol saturation; inclusion in the Roadside Questionnaire of definitive questions relative to awareness and deterrent effects of ASAP Patrols; validation of the videotape procedure in terms of the altercation rates of ASAP personnel. Comparisons with regular patrols should be compiled and analyzed, and the use of audio versus video recordings as evidence evaluated.

by John R. McIntire
County of Los Angeles, Alcohol Safety Action Project
Contract DOT-HS-161-2-252
1974; 96p
Computing assistance from the Health Sciences Computing Facility, UCLA, sponsored by NIH Special Res. Resources Grant RR-3.
Availability: Reference copy only

HS-802 309

SIoux CITY -- WOODBURY COUNTY ALCOHOL SAFETY ACTION PROJECT. AN ANALYSIS OF ASAP PATROL ACTIVITY. ANALYTIC STUDY NO. 3

The typical Alcohol Safety Action Project (ASAP) arrest procedure and strategy in Sioux City and Woodbury County, Iowa is outlined, with special aspects of ASAP patrol activity

patrol dollars. A driver profile of individuals arrested for operating a motor vehicle while under the influence of an intoxicating substance (OMVUI) during 1973 is compared with a similar profile of drivers who were fatally injured in the county during the same time frame. The ASAP Law Enforcement Countermeasure had a catalytic effect on other ASAP countermeasures and on regular patrol activities, with a decrease in accidents, increase in arrests, and the continued operation of the courts under the increased burden of a fourfold increase in cases. The following conclusions are made: the alcohol-related fatalities have been reduced, as have total accidents occurring during the hours of ASAP patrol; alcohol-related accidents in these hours have shown some reduction from the baseline years. Increased patrol through ASAP in the downtown area has caused a statistically significant shift in breaking and entering crimes. The time required to arrest, process, and book MVUI offenders has been reduced to half that required in other Iowa jurisdictions. The audio tape cassette recorders are considered to be one of the most useful devices purchased by the project. Definitive research remains to be done on blood alcohol content levels. Mobile television cameras as enforcement tools are of dubious value considering the problem experienced. Further research should be done into that area known as pre-arrest coordination testing. Roadside coordination tests should be evaluated and researched in depth to determine which one(s) is/are most indicative of the intoxicated condition of a suspect.

by Joseph L. Faltmier; John Scott; Robert J. Morrissey;
Sandra W. Trevathan; Kathleen W. Johnson; Anthony Priborsky; Joleen K. Brue
Morningside College, Social Science Res. Center, Sioux City, Iowa 51106
Contract DOT-HS-163-2-256
1974; 76p 12refs
Availability: Reference copy only

HS-802 310

LOS ANGELES COUNTY ALCOHOL SAFETY ACTION PROJECT. 1973-1975 FINAL REPORT

A \$6 million, three-year Alcohol Safety Action Project (ASAP) begun by Los Angeles County in 1972 coordinated the efforts of 14 public and private agencies, with the aim of identifying the drinker-driver and keeping him off the highways until he had been re-educated and/or rehabilitated. Prime target area was part of the San Gabriel Valley (mini-ASAP), population about 730,000. A public information campaign (including films and TV and radio spots) to encourage intervention to prevent drinking and driving received numerous awards and achieved significant results, as indicated by roadside and household surveys. Special programs were developed in five municipal court districts: East County, East Los Angeles or Montebello, south central Los Angeles, San Fernando Valley or Van Nuys, and downtown Los Angeles. Judicial activity included use of trained personnel providing pre/post sentence investigations for the judges. Approximately 40% of the driving while under the influence (DUI) offenders were identified as problem drinkers, and referral to treatment doubled over the pre-ASAP

over those in 1973. Activities in the area of licensing included training of driver improvement analysts and development of a model program to identify problem drinkers. Legislative action included making mandatory pre-sentence investigations for convicted DUI's, alternative sentences for offenders entering education or rehabilitation programs, and funding of services for problem drinkers and alcoholics. Rehabilitation activities involved centers run by the Alcoholism Council and information and referral centers, with referrals made to court schools, AA, a disulfiram clinic, recovery houses, and counseling and hospital programs. After three years of operation ASAP countermeasures were still operational and in most cases greatly expanded.

Los Angeles County Alcohol Safety Action Proj., 311 South Spring St., Suite 700, Los Angeles, Calif. 90013
Contract DOT-HS-161-2-252
1976; 123p
Rept. for 1973-1975.
Availability: Reference copy only

HS-802 311

**SAN ANTONIO ALCOHOL SAFETY ACTION
PROJECT. ANNUAL REPORT FOR 1973, SECTION
II-A-3. ANALYTIC STUDY NO. 3. AN ANALYSIS OF
ASAP LAW ENFORCEMENT ACTIVITY AND AN IN-
DEPTH COUNTERMEASURE REPORT FOR LAW
ENFORCEMENT COUNTERMEASURES**

The Enforcement Training Program was successful in increasing the ability of the San Antonio Police Dept. (SAPD) to detect and apprehend those driving while intoxicated (DWI's), and the Alcohol Safety Action Project (ASAP) had a catalytic effect on arrest rates of the regular forces of SAPD. However, efficiency in terms of DWI arrests decreased in 1973, due to a change in the "tow-in" policy which increased processing time from 60 to 90 minutes. Despite an almost fivefold increase in DWI arrests and over 14,000 traffic citations, ASAP Enforcement has not had a significant impact on the overall traffic safety system. Household surveys indicate that there has been some impact on drinking-driving behavior, but still over 60% of respondents who drink and drive indicated that they do drive after having enough alcohol to make them at least impaired. The roadside survey indicated some gains in 1972, but no further reductions in 1973. One in every ten drivers on the roads at survey sites between 7 P.M. and 3 A.M. on Friday and Saturday nights were above the presumptive limit of 0.10% BAC. Analysis of fatal and injury accidents during the period of ASAP selective enforcement failed to show positive evidence of significant impact. A questionnaire answered by 41 members of the Selective Enforcement Force of the SPAD indicated their dissatisfaction with the actions taken by the judicial system after the arrest, and an opinion by almost 50% that no amount of arrests would impact fatalities unless such arrests were coupled with more severe court action. Further recommendations were for saturation patrolling, single officer patrol units, reduction of the ASAP patrol pool to those officers who showed a high degree of enthusiasm for the project, and greater emphasis by the police administration on DWI arrests by the regular forces.

by Thomas E. Hawkins; Charles B. Dreyer
Southwest Res. Inst., P.O. Drawer 28510, 8500 Culebra Rd.,
San Antonio, Tex. 78284
Contract DOT-HS-049-1-065
1974; 52p
Availability: Reference copy only

HS-802 312

**SAFETY RELATED RECALL CAMPAIGNS FOR
MOTOR VEHICLES AND MOTOR VEHICLE
EQUIPMENT. INCLUDING TIRES - DETAILED
REPORTS FROM JULY 1, 1976 TO SEPTEMBER 30,
1976**

Tabulations of safety defect recall campaigns include NHTSA identification number, date of company notification, make, model, model year, brief description of defect and manufacturer's corrective action, number of pages on file, and number of vehicles recalled. Trucks, buses, vans, motorcycles, motor homes, passenger cars, travel trailers, street sweepers, semi trailers, snowmobile trailers, air conditioning units, steering gears, front seat back restraining devices, carburetors, wheels, gas tanks, motorcycle helmets, axles and tires are included. The status of domestic foreign campaigns completed as of 30 Sep 1976 is also given.

National Hwy. Traffic Safety Administration, Washington,
D.C. 20590
1977; 795p
Quarterly report.
Availability: NTIS

HS-802 313

**MODEL FOR PROVISIONAL (GRADUATED)
LICENSING OF YOUNG NOVICE DRIVERS. FINAL
REPORT**

A model process for the provisional (graduated) licensing of young novice drivers would retain control over young beginning drivers by issuing them provisional licenses, with full driving privileges bestowed in progressively more responsible stages. The objective would be to ease the youthful new driver into the driving environment through controlled exposure to progressively more difficult driving experiences. A model for the system was developed with the following major features: a program of parent supervised driving practice; a program of license testing and certification geared to young beginning drivers; a nighttime driving restriction (at least for young problem drivers); and a youth-oriented driver improvement program. This system was incorporated into a demonstration project work statement. If implemented, the project would operate statewide for five years. A pre-post design which compares the driving records of provisionally licensed novices with records of novices licensed prior to project implementation would be used to evaluate results. An acceptance test of the provisional model showed that it was well received. Appendices include the models of the provisional licensing system and the Provisional Licensing Review Panel; research and development materials available for the Youth License Control Demonstration project; an annotated bibliography of key references related to the project; cost estimates for the demonstration project; and two alternative evaluation designs which were seriously considered.

by Julie A. Croke; William B. Wilson
Teknekon, Inc., 4701 Sangamore Rd., Washington, D.C.
20016
Contract DOT-HS-6-01384
Rept. No. 5207; 1977; 59p
Rept. for 3 Jun 1976-7 Feb 1977.
Availability: NTIS

PHYSICS AND AUTOMOBILE SAFETY BELTS

A collection of problems and experiments related to automobile safety belt usage is designed as a supplement to a standard physics course. Its purpose is to convince physics students that the use of safety belts to prevent injury or death is firmly supported by physical laws, and that wearing safety belts while driving makes good sense. The book is divided into sections according to major physical concepts: velocity, acceleration, momentum, impulse, force, torque, energy, and stress and strain. Each section may contain short classroom demonstrations, examples and problems, and laboratory experiments, which may be used in any way that suits instructors' or students' needs. Almost every example and problem has some implication about safety belt use, and appropriate comments are included as guides. Approximately half the problems in the metric system of units. Laboratory experiments are intended to give the student an intuitive feeling for the relevant physical principles and their application to collision situations.

Department of Transportation, National Hwy. Traffic Safety Administration, Washington, D.C. 20590
1977; 78p 2refs

Availability: GPO \$1.90, Stock No. 050-003-00254-2

HS-802 315

AN INVESTIGATION OF SOME RESPONSES OF AN OUT-OF-POSITION DRIVER IN AN ACRS-EQUIPPED OLDSMOBILE DURING CRASH INDUCED BAG DEPLOYMENT. DRAFT FINAL REPORT

In the course of research concerned with improving the beneficial aspects of inflatable occupant restraint systems (air bags) an investigation was made of the possible undesirable side effects of inflating a driver air bag system against a forward positioned occupant. An accident occurred in Memphis, Tenn., in 1976 in which the driver of an Air Cushion Restraint System (ACRS)-equipped Oldsmobile died as the car struck a utility pole at a speed below the 30 mph design speed of the system. In the absence of an autopsy, the hypothesis of the Multidisciplinary Accident Investigation Team (MDAI) that the cause of death was assault to the larynx had to remain conjectural. Curb rideover tests and a pole impact test were conducted at Dynamic Science in Phoenix to consider the general problem of occupants positioned forward against inflating air bags and specifically to note any similarities with the Memphis accident. The GM ACRS steering column has a tendency to stroke further for a given crash pulse when the driver is positioned against the wheel. The MDAI hypothesis could neither be supported nor refuted by analysing the test data. Reducing the weight of the air bag cover to reduce the undemonstrated possibility of bag-induced injuries to the head/neck area include dispensing with the rubber inner cover and venting the bag material is recommended.

by David J. Biss
National Hwy. Traffic Safety Administration, Office of Vehicle Systems Res., Room 3216, Code N43-12, 2100 Second St., S.W., Washington, D.C. 20590
1977; 68p 2refs
Availability: Corporate author

ANALYSIS OF MADISON COUNTY VEHICLE DATA TO EVALUATE THE EFFECT OF AUTOCHECK PROGRAM ON VEHICLE ACCIDENT RATES. FINAL REPORT

A statistical analysis was performed to determine the effect of Autocheck program participation on the passenger vehicle accident rate in Madison County, Ala. Out of 51,025 registered passenger vehicles (model years 1968-1973), 9,696 participated in the Autocheck program during the period 1 Apr 1975-30 Apr 1976. During this same period 5,956 passenger vehicles registered in the county were involved in an accident within the county. Statistics derived from the data processing showed that Autocheck vehicles had a slightly higher estimated accident rate (12.0%) than the non-Autocheck vehicles (11.6%), which did not support the hypothesis that the Autocheck participant accident rate was lower than for non-participants. An additional, more detailed accident rate contrast performed for Huntsville vehicles similarly gave no indication of any improvement due to Autocheck operation.

by Bruce Gibbs; William Hatch
Automated Sciences Group, Inc., 8555 16th St., Suite 713, Silver Spring, Md. 20910
Contract DOT-HS-6-01338
Rept. No. ASGI-TR-76-22; 1977; 38p
Rept. for May-Dec 1976.
Availability: NTIS

HS-802 317

TRUCK AND BUS SAFETY SUBCOMMITTEE MEETING, TRANSCRIPT OF PROCEEDINGS, VOL. 1, 17 MARCH 1977

Topics of an NHTSA Truck and Bus Safety Subcommittee Meeting include an overview of FMVSS 121's basic requirements, cost benefits, implementation schedule, required load times, maintenance history (both cost and frequency), and operational experiences of both owners and drivers. Presentations by 15 people representing vehicle manufacturers, suppliers, associations, California Highway Patrol, and U.P.S. outline impact of FMVSS 121 on respective organizations, and offer recommendations for future implementation and evaluation of 121. Air-braking systems of trucks, buses, and trailers are covered by FMVSS 121, specifically to regulate equipment and alleviate chronic stopping performance and skidding problems. As of December 1976, 16% of the truck population, 7% of trailers, and 13% of buses were equipped according to 121 standards; impact of specified equipment on accident incidence is currently inconclusive. Operating and system maintenance costs appear to be up. Sensor problems and electromagnetic interference are major design defects in some equipment meeting 121 specifications. Manufacturers report shorter lining and drum lives, higher maintenance costs, electrical system defects, and incompatibility between 121 and pre-121 equipment for brake anti-lock systems. Safety benefits are questioned in relation to increased technical personnel training, production, and maintenance costs. Inadequate time for analysis, review, and feedback for 121 regulations prior to implementation is consistently cited. Defects in 121 systems leading to breakdown and accidents are often not properly documented. A moratorium on 121-specified wheel antilock system is recommended pending new, safer designs. NHTSA is asked to exempt vehicles with peculiar configurations or uses, such as crane carriers, from antilock brake system requirements.

Better monitoring of accident and maintenance records on 121 systems is considered essential for standards establishment and enforcement. A number of specific design changes are suggested, such as introduction of O-rings into sensor design to prevent intrusion of water, automatic brake adjusters, pressure relief valves, and high temperature air compressor discharge lines. Increased compliance enforcement is requested in order to establish equal cost and timing readjustments by all manufacturers concerned. A technical forum should be set up to research and establish FMVSS 121 standards and to monitor problems.

U.S. Department of Transportation. National Hwy. Safety Advisory Council, National Motor Vehicle Safety Advisory Council
1977; 359p
Vol. F is HS-802 318.
Availability: Ace-Federal Reporters, Inc., 444 North Capitol St., Washington, 20001

HS-802 318

TRUCK AND BUS SAFETY SUBCOMMITTEE MEETING, TRANSCRIPT OF PROCEEDINGS, VOL. 2, 18 MARCH 1977

Ten presentations regarding Federal Motor Vehicle Safety Standard (FMVSS) 121 include a representative's of the National Center for Statistical Analysis report on plans for a field evaluation of 121 effects on accident and operational experience of 121-equipped vehicles, based on data obtained from monitoring about 3000 pre-standard and post-standard trucks over a two-year period, Jan. 1976 to Dec. 1977. Representatives of the National Solid Wastes Management Association and a trucking company discuss the unique operational characteristics of refuse trucks deserving special provisions under 121, for example, amount of time spent at slow speed and extreme operating conditions at landfills. Excessive downtime is reported for refuse trucks with 121 brake systems. A three-year exemption of electrical and circuitry 121 requirements is recommended for the refuse industry. A manufacturer of container-type chassis equipment reports extensive failures of 121 systems on chassis and on tractors and trailers in Alaska, and recommends a technical working group for revision of 121. A representative of International Harvester, Inc. focuses on problems with 121 antikick requirements, from inappropriate applications to cost-benefit analysis. A brake supplier company speaker discusses basic pneumatic and antilock wheel systems under 121, contending that the former is generally reliable but the latter are generally inferior to pre-121 systems. Governmental activity should concentrate on setting performance standards rather than design standards. A statement by a representative of a mass transit administration and a transit management company reports shortened brake lining life and problems with antilock feature, and recommends deferred effective date for bus stopping requirement pending redesign. A bus manufacturer recommends optional status of antikick systems until better designs are available. FMVSS 121 standards and regulations are protested based on high incidence of documented brake system failures, and based on NHTSA's refusal to adopt Breeze Inc.'s jackknife control system as an alternative. A union representative advocates tightening of brake standards and enforcement, and better driver education on 121 systems. A report on a survey by the Senate Human Resources Committee notes questionable reliability of electronic brake systems and value of antilock safety valves, and importance of a better data base of accident in-

vestigations. A statement from the Bureau of Motor Carrier Safety indicates that informational surveys will be conducted on FMVSS-121 equipped vehicles before standards are enforced. An afternoon session includes discussion of presentations, FMVSS-121 regulations, and recommendations. Resolutions include changes in wording of regulations; restriction of NHTSA to promulgation of safety performance standards and not design standards; recommendation that the Secretary should publish his interpretation of the applicability of 121 regarding retrofitting of post-Notice 07 equipment on pre-Notice 07 vehicles; permanent exemption of cranes and garbage trucks, and temporary exemption for buses from FMVSS 121.

U.S. Department of Transportation. National Hwy. Safety Advisory Council, National Motor Vehicle Safety Advisory Council
1977; 274p
Vol. 1 is HS-802 317.
Availability: Ace-Federal Reporters, Inc., 444 North Capitol St., Washington, D.C. 20001

HS-802 319

YIELDING BARRIER TEST DATA BASE - A STUDY OF SIDE IMPACT CASES IN THE MULTI- DISCIPLINARY ACCIDENT INVESTIGATION (MAI)FILE

Reconstruction of 259 Multi-Disciplinary Accident Investigation (MDAI) side impact cases using the Calspan Reconstruction of Accident Speeds on the Highway (CRASH)2 computer program is summarized in order to achieve a refined definition of the present collision environment in lateral impacts. Because of the CRASH2 format for accident data was not in existence at the time of the MDAI data collection, documentation and coding problems exist in analysis. Frequency distributions for all input variables and two-way tabulations of selected variables which aid in defining crash environment for side impacts are included. Results indicate no significant difference between distribution of principal force for the left and right side directions. Analysis of impact orientation, referring to the difference between heading angles of two impacting vehicles in degrees, shows highest frequencies (46.6%) at 61° to 90° (90° meaning broadside). Side collisions for 48 vehicles are analyzed using impact speeds of striking and struck vehicle for right and left side impacts; a better agreement in estimates exists for the striking rather than the struck vehicle. "Closing velocity," the velocity of approach of the centers of gravity of two vehicles, directly affects speed changes of vehicles and can be substantially different in perpendicular side collisions as opposed to end collisions with the same vehicle speeds. Two estimates of speed changes experienced by two vehicles show that smaller, lighter vehicles are exposed to speed changes generally larger than those for full size vehicles. Injury thresholds, measured as a function of (delta) V and direction of occupant motion and examined for compact and full size automobiles, show that occupants of larger vehicles have increased protection against severe and fatal injuries at the cost of a reduced threshold to minor injuries (AIS 1 and 2). Vehicle damage, measured in terms of maximum crush, length and depth, shows median value of crush to be the same regardless of length of damage. Further research using this analytical technique is recommended for larger sample sizes.

Appendices present case coding form, summary of reconstruction results, and data format for analysis of results.

by Raymond R. McHenry; A. Stephen Baum; Donald O. Neff
Calspan Corp., 4455 Genesee St., Buffalo, N.Y. 14221
Contract DOT-HS-01372
1977; 74p 9refs
Availability: NTIS

the legal requirement to wear motorcycle protective headgear and the 55 mph national speed limit.

by Joan Claybrook
Department of Transportation, Washington, D.C. 20590
1977; 9p
Availability: NTIS

HS-802 335

STANDARDS ENFORCEMENT TEST REPORTS INDEX FOR 1976

The eighth in a series of indexes to the Standards Enforcement Test Reports covers material released to the public during calendar year 1976, with listings arranged according to manufacturer, model year, model or part number, failures, Federal Motor Vehicle Safety Standard (FMVSS) number, component or vehicle ID (NHTSA number), laboratory test number, Certification Investigation Report (CIR) number, HS number, brand or seller, and tire size or body style (within each, alphabetically and numerically arranged).

Department of Transportation, National Hwy. Traffic Safety
Administration
NHTSA-6-5801
1977; 1235p
Availability: NTIS

HS-810 302

SPEECH BEFORE THE NATIONAL COMMITTEE ON UNIFORM TRAFFIC LAWS AND ORDINANCES

With respect to the requirement by the Highway Safety Act of 1976 for the Secretary of Transportation to examine the Highway Safety Program, modifications to the program, with particular emphasis on the utility of the present Highway Safety Program Standards, are proposed. A major recommendation is that while a federal requirement for mandatory compliance with 18 standards was a reasonable way to initiate a new National Highway Safety Program in 1966, this requirement could not be supported in 1977. The Federal insistence on rigid uniformity by all states of every item of every standard can stifle innovation and discourage concentration on important regional problems. However, there are obvious areas where uniformity at the national level is an essential component of any safety program, for example, where a standard affects the driving environment or where a standard provides the basic structure for the program. In many of these areas, the Uniform Vehicle Code will be the point of departure for the development of Highway Safety Program Standards. The development of the following six requirements where compliance will be mandatory is recommended: rules of the road, driver licensing, vehicle registration and titling, traffic record systems, highway design standards, and traffic control devices. The adoption of uniform traffic record systems is given high priority. With regard to the National Driver Register (NDR), it is felt that this system is antiquated and should either be replaced with an on-line system or eliminated. From the Federal perspective, concentration on the following problems is encouraged: the over-involvement of youthful drivers in accidents, the drinking driver, and the slaughter of pedestrians. Two areas in particular which are supported are

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- Fraize, Willard E.**
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ENERGY AND ENVIRONMENTAL ASPECTS OF U.S.
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- Green, John A.**
MULTIDISCIPLINARY ACCIDENT INVESTIGATION
DATA FILE 1975. FINAL REPORT
- Grime, G.**
PROBABILITIES OF INJURY IN ROAD ACCIDENTS
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ANALYSIS OF MADISON COUNTY VEHICLE DATA
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HS-802 316
- Hawkins, Thomas E.**
SAN ANTONIO ALCOHOL SAFETY ACTION PRO-
JECT. ANNUAL REPORT FOR 1973, SECTION II-A-3.
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- Kannel, J. W.**
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- Leib, John**
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- Lippert, William**
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- Matyja, F. E.**
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- Maximena, Delores E. , comp.**
ELECTRIC VEHICLES 1890 - 1966. A BIBLIOGRAPHY
HS-020 708
- McFarland, R. A.**
AN ANALOG HEAT RELEASE COMPUTER PROGRAM FOR ENGINE COMBUSTION EVALUATION
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- McGill, D. W.**
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- YIELDING BARRIER TEST DATA BASE - A SUMMARY OF SIDE IMPACT CASES IN THE MULTIDISCIPLINARY ACCIDENT INVESTIGATION (MAI) FILE
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- YIELDING-BARRIER TEST DATA BASE-REPRESENTATION OF DAMAGE DATA TABLES IN THE CRASH PROGRAM. INTERIM REPORT
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- McIntire, John R.**
PRELIMINARY ANALYSIS OF LAW ENFORCEMENT COUNTERMEASURES. ANALYTIC STUDY FOR THE
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STATIONARY FIXTURE SYSTEMS FOR THE AUTOMATIC FILLING OF A CAVITY WITH URETHANE FOAM
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HUMID AGE COMPRESSION SET IN POLYURETHANE FOAM
HS-020 708

- Michaels, David**
A DESIGNER'S GUIDE FOR HEAVY DUTY TRUCK
WIRING HARNESSSES
HS-020 764
- Mikes, Richard J.**
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- Miller, R. F.**
EFFECT OF PAVEMENT TEXTURE ON
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MEASUREMENT PROBLEMS
HS-020 827
- Mills, W. D.**
THE VAPIPE - A PRACTICAL SYSTEM FOR PRODUC-
ING HOMOGENEOUS GASOLINE-AIR MIXTURES
HS-020 726
- Mobley, Emily R. , ed.**
ELECTRIC VEHICLES 1890 - 1966. A BIBLIOGRAPHY
HS-020 706
- Morris, R. S.**
FIELD STUDY OF DRIVER VISUAL PERFORMANCE
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HS-802 289
- Morrisey, Robert J.**
SIOUX CITY -- WOODBURY COUNTY ALCOHOL
SAFETY ACTION PROJECT. AN ANALYSIS OF ASAP
PATROL ACTIVITY. ANALYTIC STUDY NO. 3
HS-802 309
- Morrison, E. L. , Jr.**
ELECTROMAGNETIC INTERFERENCE EFFECTS ON
MOTOR VEHICLE ELECTRONIC CONTROL AND
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GUIDELINES. FINAL REPORT
HS-802 109
- Mounce, J. M.**
FIELD STUDY OF DRIVER VISUAL PERFORMANCE
DURING RAINFALL. FINAL REPORT
HS-802 289
- Mungenast, Jeanie S.**
RESTRAINT SYSTEMS EVALUATION PROJECT
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HS-802 285
- Neff, Donald O.**
YIELDING BARRIER TEST DATA BASE - A STUDY
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- Nesbitt, M. W.**
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- Nilsson, Nils-Ake**
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- O'Leary, K. L.**
TOWARD 2000: OPPORTUNITIES IN TRANSPORTA-
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HS-020 695
- O'Neill, Brian**
NEW-CAR BUMPERS FLOUT INTENT OF '72 LAWS,
IIHS TESTS SHOW
HS-020 780
- Oliver, David C.**
LIABILITY AND HIGHWAY-SAFETY PRACTICES
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AN INTEGRATED APPROACH TO MEASUREMENT
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HS-020 745
- Oswald, L. J.**
POSSIBLE EFFECT OF VEHICLE AERODYNAMIC
NOISE ON SAE J57a PASSBY NOISE MEASURE-
MENTS
HS-020 834
RESEARCH ON INDIVIDUAL SOURCE MECHANISMS
OF TRUCK TIRES: AEROACOUSTIC SOURCES
HS-020 837
- Owen, Charles J.**
A DESIGNER'S GUIDE FOR HEAVY DUTY TRUCK
WIRING HARNESSSES
HS-020 764
- Pangborn, J. B.**
HYDROGEN AUTOMOTIVE FUEL: PRODUCTION
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HS-020 729
- Papay, Andrew G.**
ADVANCES IN HYDRAULIC OIL ADDITIVE
TECHNOLOGY
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- Pape, W. S.**
SUGGESTED SAE STANDARD FOR IDENTIFYING
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- Patten, W.**
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- Peck, R. C.**
LONGITUDINAL STUDY OF CALIFORNIA DRIVER
ACCIDENT FREQUENCIES I: AN EXPLORATORY
MULTIVARIATE ANALYSIS. FINAL REPORT
HS-020 689
- Penaluna, Kenneth D.**
ECONOMIC AND MOBILITY CONSIDERATIONS IN
TRUCK TIRE AND RETREAD SELECTION
HS-020 814
- Perrine, M. W.**
ALCOHOL EXPERIMENTS ON DRIVING-RELATED
BEHAVIOR: A REVIEW OF THE 1974 ALCOHOL
COUNTERMEASURES LITERATURE. FINAL REPORT
HS-802 293

- Peterson, Kenneth G.**
GENERAL MOTORS PASSENGER TIRE PERFORMANCE CRITERIA
HS-020 822
- Pollard, J. K.**
TRANSPORTATION ENERGY CONSERVATION OPTIONS (DRAFT)
HS-020 756
- Pope, Joseph**
TIRE NOISE GENERATION: THE ROLES OF TIRE AND ROAD
HS-020 838
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A USER'S GUIDE TO POSITIVE GUIDANCE
HS-020 810
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BUS TRANSIT
HS-020 766
- Potter, R. I.**
SYNTHETIC AUTOMOTIVE ENGINE OILS FROM A CONSULTANT'S EXPERIENCE
HS-020 723
- Preston, F. L.**
A METHODOLOGY FOR DETERMINING THE ROLE OF VEHICLE HANDLING IN ACCIDENT CAUSATION. VOL. 1. TECHNICAL REPORT AND APPENDIX A
HS-802 261
A METHODOLOGY FOR DETERMINING THE ROLE OF VEHICLE HANDLING IN ACCIDENT CAUSATION. VOL. 2. APPENDICES B, C, D, E
HS-802 262
- Priborsky, Anthony**
SIOUX CITY -- WOODBURY COUNTY ALCOHOL SAFETY ACTION PROJECT. AN ANALYSIS OF ASAP PATROL ACTIVITY. ANALYTIC STUDY NO. 3
HS-802 309
- Price, Harold E.**
A USER'S GUIDE TO POSITIVE GUIDANCE
HS-020 810
- Puustelli, M.**
ANALYSIS OF ROAD TRAFFIC ACCIDENTS DATA IN ZAMBIA
HS-020 782
- Queen, J. E.**
SYSTEMS ANALYSIS OF THE VISIBILITY REQUIREMENTS OF PASSENGER CAR DRIVERS. FINAL TECHNICAL REPORT
HS-802 290
- Reid, K. A.**
A LABORATORY PROCEDURE FOR MEASURING THE SOUND LEVEL OF TRUCK TIRES
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Harry Diamond Lab., 2800 Powder Mill Rd., Adelphi, Md. 20783

TOWARDS A LOW COST HIGHLY RELIABLE ANTI-LOCK BRAKE SYSTEM FOR SMALL MOTORCYCLES. FINAL REPORT
HS-802 288

Highway Safety Res. Inst., Huron Pkwy. and Baxter Rd., Ann Arbor, Mich. 48109

MULTIDISCIPLINARY ACCIDENT INVESTIGATION DATA FILE. 1975. FINAL REPORT
HS-802 291

Hoover Ball and Bearing Co., Whitmore Lake, Mich. 48189

THE COMPRESSION SET AND RELATED PROPERTIES OF FLEXIBLE URETHANE FOAM
HS-020 804

Institute of Gas Technology

HYDROGEN AUTOMOTIVE FUEL: PRODUCTION AND DELIVERY
HS-020 729

Insurance Inst. for Highway Safety, 600 New Hampshire Ave., N.W., Washington, D.C. 20037

NEW-CAR BUMPERS FLOUT INTENT OF '72 LAWS, IIHS TESTS SHOW
HS-020 780

Insurance Inst. for Hwy. Safety

AUTOMOBILE SEATBELT USE IN SELECTED COUNTRIES, STATES AND PROVINCES WITH AND WITHOUT LAWS REQUIRING BELT USE
HS-020 705

PUBLIC HEARING ON OCCUPANT CRASH PROTECTION. ALTERNATIVES FOR PASSENGER CARS
HS-020 704

International Harvester Co.

SUGGESTED SAE STANDARD FOR IDENTIFYING AUTOMOTIVE WIRING CIRCUITS
HS-020 765

International Harvester Co., Truck Div., Engineering Center, Fort Wayne, Ind.

TRUCK ELECTRICAL SYSTEMS
HS-020 702

IFM Akustikbyran AB, Sweden

TIRE NOISE SCREENING
HS-020 843

IFM-Akustikbyran AB, Sweden

ON GENERATING MECHANISMS FOR EXTERNAL TIRE NOISE
HS-020 841

Los Angeles County Alcohol Safety Action Proj., 311

South Spring St., Suite 700, Los Angeles, Calif. 90013
LOS ANGELES COUNTY ALCOHOL SAFETY ACTION PROJECT. 1973-1975 FINAL REPORT
HS-802 310

M and T Chemicals Inc., Rahway, N.J. 07065

TIN CATALYST PERFORMANCE IN HIGH RESILIENCY FOAM
HS-020 799

Ministere des Communications, Belgium

THE CRASH HELMET. STATISTICAL SURVEY OF ACCIDENTS INVOLVING INJURED MOTORCYCLISTS WITH OR WITHOUT CRASH-HELMET: 1973-1975
HS-020 691

Mitre Corp.

ENERGY AND ENVIRONMENTAL ASPECTS OF U.S. TRANSPORTATION
HS-020 752

Mobay Chemical Corp., Penn Lincoln Pkwy. West, Pittsburgh, Pa. 15205 p75-81

HIGH MODULUS RIM ELASTOMERS FOR EXTERIOR AUTOMOTIVE PARTS
HS-020 807

Mobay Chemical Corp., Pittsburgh, Pa.

STATIONARY FIXTURE SYSTEMS FOR THE AUTOMATIC FILLING OF A CAVITY WITH URETHANE FOAM
HS-020 794

Morningside College, Social Science Res. Center, Sioux City, Iowa 51106

SIoux CITY -- WOODBURY COUNTY ALCOHOL SAFETY ACTION PROJECT. AN ANALYSIS OF ASAP PATROL ACTIVITY. ANALYTIC STUDY NO. 3

HS-802 309

National Aeronautical Establishment

A PARAMETRIC STUDY ON HIGHWAY CABLE BARRIER PERFORMANCE AND ITS EFFECT ON VEHICLE REDIRECTION DYNAMICS

HS-020 792

National Bureau of Standards, Washington, D.C.

EMPIRICAL MODEL FOR PREDICTING IN-SERVICE TRUCK TIRE NOISE LEVELS

HS-020 852

TEST PROCEDURES FOR FUTURE TIRE NOISE REGULATIONS

HS-020 849

National Engineering Lab., Scotland

THE VAPIPE - A PRACTICAL SYSTEM FOR PRODUCING HOMOGENEOUS GASOLINE-AIR MIXTURES

HS-020 726

National Hwy. Traffic Safety Administration, National Center for Statistics and Analysis, 2100 Second St., S.W., Washington, D.C. 20590

FY 1977 IMPLEMENTATION OF THE NATIONAL ACCIDENT SAMPLING SYSTEM

HS-802 260

National Hwy. Traffic Safety Administration, National Center for Statistics and Analysis, Washington, D.C. 20590

RESTRAINT SYSTEMS EVALUATION PROJECT CODEBOOK

HS-802 285

National Hwy. Traffic Safety Administration, Office of State Vehicle Progs., Washington, D.C. 20590

FUEL ECONOMY IMPROVEMENT THROUGH DIAGNOSTIC INSPECTION

HS-802 284

National Hwy. Traffic Safety Administration, Office of Vehicle Systems Res., Room 3216, Code N43-12, 2100 Second St., S.W., Washington, D.C. 20590

AN INVESTIGATION OF SOME RESPONSES OF AN OUT-OF-POSITION DRIVER IN AN ACRS-EQUIPPED OLDSMOBILE DURING CRASH INDUCED BAG DEPLOYMENT. DRAFT FINAL REPORT

HS-802 315

National Hwy. Traffic Safety Administration, Technical Services Div., Washington, D.C. 20590

YOUTH AND DRIVING: A SUBJECT BIBLIOGRAPHY FROM HIGHWAY SAFETY LITERATURE

HS-802 306

National Hwy. Traffic Safety Administration, Washington, D.C.

A REVIEW OF THE SAFETY HAZARD DUE TO POOR HEALTH, DRUGS, AND THEIR INTERACTION

HS-020 701

National Hwy. Traffic Safety Administration, Washington, D.C. 20590

SAFETY RELATED RECALL CAMPAIGNS FOR MOTOR VEHICLES AND MOTOR VEHICLE EQUIPMENT. INCLUDING TIRES - DETAILED REPORTS FROM JULY 1, 1976 TO SEPTEMBER 30, 1976

HS-802 312

National Res. Council Canada, Ottawa, Ont., Canada

A PARAMETRIC STUDY ON HIGHWAY CABLE BARRIER PERFORMANCE AND ITS EFFECT ON VEHICLE REDIRECTION DYNAMICS

HS-020 792

National Safety Council, 444 N. Michigan Ave., Chicago, Ill. 60611

ALCOHOL EXPERIMENTS ON DRIVING-RELATED BEHAVIOR: A REVIEW OF THE 1974 ALCOHOL COUNTERMEASURES LITERATURE. FINAL REPORT

HS-802 293

Nelson Industries, Inc., Corporate Res. Dept.

AN INTEGRATED APPROACH TO MEASUREMENT OF EXHAUST AND INTAKE NOISE

HS-020 745

North Carolina State Univ., Mechanical and Aerospace Engineering Dept.

THE RELATIONSHIP BETWEEN TRUCK TIRE VIBRATION AND NEAR AND FAR FIELD SOUND LEVELS

HS-020 836

Oak Ridge National Lab.

ENERGY CONSUMPTION FOR TRANSPORTATION IN THE UNITED STATES

HS-020 754

Oak Ridge National Lab.

TRANSPORTATION ENERGY CONSERVATION: OPPORTUNITIES AND POLICY ISSUES

HS-020 755

Polysar Ltd.

EXTENDED LIFE FOR TRANSMISSION COMPONENTS THROUGH LIMITED AIR BREATHING

HS-020 735

Power-Matic Corp.

MECHANAPOWER: A NEW APPROACH TO INFINITELY VARIABLE TRANSMISSIONS (DOMESTIC AND FOREIGN PATENTS IN PROCESS)

HS-020 741

Psychological Res. Foundation of Vermont, Inc., P.O. Box 867, Burlington, Vt. 05401

ON-THE-ROAD DRIVING BEHAVIOR AND BREATH ALCOHOL CONCENTRATION. FINAL REPORT

HS-802 264

Purdue Univ., Joint Hwy. Res. Proj., West Lafayette, Ind. 47907

TRAFFIC SPEED REPORT NO. 99

HS-020 759

TRAFFIC SPEED REPORT NO. 98

HS-020 760

Ray Potter and Associates

Ruan Companies

ECONOMIC AND MOBILITY CONSIDERATIONS IN
TRUCK TIRE AND RETREAD SELECTION

HS-020 814

Ruan Transport Corp.

ECONOMIC AND MOBILITY CONSIDERATIONS IN
TRUCK TIRE AND RETREAD SELECTION

HS-020 814

Rubber Mfrs. Assoc.

AN INDUSTRY VIEWPOINT OF TIRE SOUND REDUC-
TION AND MEASUREMENT METHODOLOGY

HS-020 835

Rubber Mfrs. Assoc.

NOISE REGULATIONS -- IMPACTS AND RESTRAINTS

HS-020 851

Ryder Truck Lines, Inc.

TIRE USE IN A COMMON CARRIER FLEET

HS-020 816

Shell Res. Ltd., Thornton Res. Center, United Kingdom
THE VAPIPE - A PRACTICAL SYSTEM FOR PRODUC-
ING HOMOGENEOUS GASOLINE-AIR MIXTURES

HS-020 726

Sheller Globe Corp., Leece Neville Div.

SURVEY OF TRUCK ELECTRICAL CRANKING
SYSTEMS

HS-020 763

Society of the Plastics Industry, Cellular Plastics

Division, 355 Lexington Ave., New York, N.Y. 10017
CELLULAR PLASTICS IN TRANSPORTATION

HS-020 793

Society of Automotive Engineers, Inc., 400

Commonwealth Dr., Warrendale, Pa. 15096
SAE HIGHWAY TIRE NOISE SYMPOSIUM

PROCEEDINGS, SAN FRANCISCO, NOVEMBER 10-12,
1976

HS-020 811

**Southwest Res. Inst., P.O. Drawer 28510, 8500 Culebra
Rd., San Antonio, Tex. 78284**

SAN ANTONIO ALCOHOL SAFETY ACTION PRO-
JECT. ANNUAL REPORT FOR 1973, SECTION II-A-3.
ANALYTIC STUDY NO. 3. AN ANALYSIS OF ASAP
LAW ENFORCEMENT ACTIVITY AND AN IN-DEPTH
COUNTERMEASURE REPORT FOR LAW ENFORCE-
MENT COUNTERMEASURES

HS-802 311

Stanford Univ., Dept. of Mechanical Engineering

TIRE NOISE GENERATION: THE ROLES OF TIRE
AND ROAD

HS-020 838

**Teknekron, Inc., 4701 Sangamore Rd., Washington, D.C.
20016**

MODEL FOR PROVISIONAL (GRADUATED)
LICENSING OF YOUNG NOVICE DRIVERS. FINAL
REPORT

HS-802 313

Texaco Res. Center

SCANNING ELECTRON MICROSCOPE STUDIES OF

**Texas Transportation Inst., Texas A and M Univ.,
College Station, Tex. 77801**

FIELD STUDY OF DRIVER VISUAL PERFORMANCE
DURING RAINFALL. FINAL REPORT

HS-802 289

**Traffic Accident Res. Unit, Dept. of Motor Transport,
P.O. Box 28, Sydney, N.S.W., Australia**
SIDE IMPACTS AND LAP-SASH BELTS

HS-020 711

OCCUPANT HEAD SPACE IN PASSENGER CARS

HS-020 712

IN-DEPTH ANALYSIS OF FATALITIES TO WEARERS
OF SEAT BELTS

HS-020 713

CRASH PERFORMANCE OF EMERGENCY LOCKING
RETRACTOR SEAT BELTS

HS-020 714

CHILD RESTRAINT SIZE

HS-020 715

ANATOMICAL FACTORS IN LAP/SASH SEATBELT
WEARING

HS-020 716

Transcon Lines

CURRENT FLEET TIRE ECONOMICS

HS-020 815

**Transportation Systems Center, Kendall Square,
Cambridge, Mass. 02142**

VEHICLE TEST PROCEDURE DRIVING SCHEDULES.
FINAL REPORT

HS-020 777

**U.S. Department of Transportation. National Hwy. Safety
Advisory Com., National Motor Vehicle Safety Advisory
Council**

TRUCK AND BUS SAFETY SUBCOMMITTEE MEET-
ING, TRANSCRIPT OF PROCEEDINGS, VOL. 1, 17
MARCH 1977

HS-802 317

TRUCK AND BUS SAFETY SUBCOMMITTEE MEET-
ING, TRANSCRIPT OF PROCEEDINGS, VOL. 2, 18
MARCH 1977

HS-802 318

**U.S. Department of Transportation. National Hwy. Safety
Advisory Com., Highway Environment Sub-Committee**
HIGHWAY ENVIRONMENT SUB-COMMITTEE. FINAL
REPORT

HS-020 778

**U.S. Dept. of Transportation, Federal Hwy.
Administration, Office of Traffic Operations**

IMPROVING THE HIGHWAY SYSTEM BY UPGRAD-
ING AND OPTIMIZING TRAFFIC CONTROL DEVICES

HS-020 758

U.S. Energy Res. and Devel. Administration

RECENT PROGRESS IN THE HYDROGEN ENGINE

HS-020 731

**Union Carbide Corp., Chemicals and Plastics Res. and
Devel. Dept., South Charleston, W. Va. 25303**

HIGH RESILIENCY URETHANE FOAMS FOR AU-
TOMOTIVE SEATING APPLICATIONS

september 30, 1977

Union Carbide Corp., Chemicals and Plastics Res. and Devel. Dept., South Charleston, W. Va. 25303
FACTORS AFFECTING THE MODULUS AND RELAXATION PROPERTIES OF LIQUID REACTION MOLDED URETHANE ELASTOMERS

HS-020 808

Union Carbide Corp., Tarrytown, N.Y. 10591
MECHANICALLY FROTHED URETHANE: A NEW PROCESS FOR CONTROLLED GAUGE, HIGH DENSITY FOAM

HS-020 795

Uniroyal Tire Co.
A LABORATORY PROCEDURE FOR MEASURING THE SOUND LEVEL OF TRUCK TIRES

HS-020 830

THE ENVIRONMENTAL, COMMERCIAL AND REGULATORY IMPLICATIONS OF SAE RECOMMENDED PRACTICE J57a FOR TRUCK TIRE SOUND LEVELS

HS-023 850

University of California - Berkeley, Dept. of Mechanical Engineering
ROTARY ENGINE COMBUSTION WITH HYDROGEN ADDITION

HS-020 761

University of Massachusetts, Amherst
ENERGY REQUIREMENTS FOR PASSENGER GROUND TRANSPORTATION SYSTEMS

HS-020 753

University of Michigan Regents, Ann Arbor, Mich.
TEMPERATURE EFFECTS ON ROLLING RESISTANCE OF PNEUMATIC TIRES. INTERIM REPORT

HS-020 708

University of Michigan, Hwy. Safety Res. Inst.
SURVEY OF THE PERFORMANCE OF INFANT AUTO RESTRAINT SYSTEMS SOLD IN THE UNITED STATES AND CANADA. FINAL REPORT

HS-020 696

THE NOISE AND HIGHWAY TRACTION PROPERTIES OF HEAVY TRUCK TIRES

HS-020 844

University of Michigan, Hwy. Safety Res. Inst., Ann Arbor, Mich. 48109
A FOUNDATION FOR SYSTEMS ANTHROPOMETRY, PHASE 1. INTERIM SCIENTIFIC REPORT

HS-020 767

University of Michigan, Hwy. Safety Res. Inst., Ann Arbor, Mich. 48109
GUIDEBOOK ON ANTHROPOMORPHIC TEST DUMMY USAGE

HS-020 787

University of Michigan, Hwy. Safety Res. Inst., Huron Pkwy. and Baxter Rd., Ann Arbor, Mich. 48109
PREDICTING THE BRAKING PERFORMANCE OF TRUCKS AND TRACTOR-TRAILERS. PHASE 3 TECHNICAL REPORT. APPENDICES A, B, C, D, E, F

HS-020 692

University of Michigan, Hwy. Safety Res. Inst., Huron Pkwy. and Baxter Rd., Ann Arbor, Mich. 20014
CERVICAL INJURIES: FREQUENCY, ETIOLOGY, AND SEVERITY

HS-020 709

University of Michigan, Hwy. Safety Res. Inst., Huron Pkwy. and Baxter Rd., Ann Arbor, Mich. 48109
MOTORCYCLE BRAKING PERFORMANCE. SUMMARY TECHNICAL REPORT. VOL. 1

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MOTORCYCLE BRAKING PERFORMANCE. FINAL TECHNICAL REPORT. VOL. 2

HS-802 258

MOTORCYCLE BRAKING PERFORMANCE. APPENDICES A, B, C, D, E, F. VOL. 3

HS-802 259

A METHODOLOGY FOR DETERMINING THE ROLE OF VEHICLE HANDLING IN ACCIDENT CAUSATION. VOL. 1. TECHNICAL REPORT AND APPENDIX A

HS-802 261

A METHODOLOGY FOR DETERMINING THE ROLE OF VEHICLE HANDLING IN ACCIDENT CAUSATION. VOL. 2. APPENDICES B, C, D, E

HS-802 262

University of Southern California, Inst. of Safety and Systems Management, Los Angeles, Calif. 90007
RESTRAINT SYSTEMS EVALUATION PROGRAM. FINAL REPORT

HS-802 286

University of Tennessee, Transportation Center, Knoxville, Tenn. 37916
INCREASED TRANSPORTATION EFFICIENCY THROUGH RIDESHARING: THE BROKERAGE APPROACH. VOL.1. FINAL REPORT

HS-020 786

Urethane Facilities Engineering
STATIONARY FIXTURE SYSTEMS FOR THE AUTOMATIC FILLING OF A CAVITY WITH URETHANE FOAM

HS-020 794

Wagner Electric Corp.
AN EQUIPMENT SUPPLIER'S VIEW ON REGULATIONS

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11-8864 nology, Inc.	HS-020 810	DOT-HS-5-01124 Calspan Corp., 4455 Genesee St., Buffalo, N.Y. 14221 HS-802 287
OS-60156 Corp.	HS-020 845	DOT-HS-5-01133 Harry Diamond Lab., 2800 Powder Mill Rd., Adelphi, Md. 20783 HS-802 288
-010-1-176 ity of Southern California, Inst. of Safety and s Management, Los Angeles, Calif. 90007	HS-802 286	DOT-HS-5-01134 Highway Safety Res. Inst., Huron Pkwy. and Baxter Rd., Ann Arbor, Mich. 48109 HS-802 291
-01372 Corp., 4455 Genesee St., Buffalo, N.Y. 14221	HS-802 319	DOT-HS-5-01172 Texas Transportation Inst., Texas A and M Univ., College Station, Tex. 77801 HS-802 289
i-049-1-065 vest Res. Inst., P.O. Drawer 28510, 8500 Culebra Rd., tonio, Tex. 78284	HS-802 311	DOT-HS-5-01202 Dunlap and Associates, Inc., Western Div., 115 South Oak St., Inglewood, Calif. 90301 HS-802 290
3-161-2-252 f of Los Angeles, Alcohol Safety Action Project	HS-802 308	DOT-HS-5-01264 University of Michigan, Hwy. Safety Res. Inst., Huron Pkwy. and Baxter Rd., Ann Arbor, Mich. 48109 HS-802 257
ngeles County Alcohol Safety Action Proj., 311 South St., Suite 700, Los Angeles, Calif. 90013	HS-802 310	University of Michigan, Hwy. Safety Res. Inst., Huron Pkwy. and Baxter Rd., Ann Arbor, Mich. 48109 HS-802 258
S-163-2-256 gside College, Social Science Res. Center, Sioux City, 51106	HS-802 309	University of Michigan, Hwy. Safety Res. Inst., Huron Pkwy. and Baxter Rd., Ann Arbor, Mich. 48109 HS-802 259
S-355-3-718 chnology, Inc., 3027 Rosemary Lane, Falls Church, 2042	HS-802 266	DOT-HS-5-01268 Applied Science Associates, Inc., Box 158, Valencia, Pa. 16059 HS-802 292
IS-364-3-757 nological Res. Foundation of Vermont, Inc., P.O. Box Burlington, Vt. 05401	HS-802 264	DOT-HS-6-01338 Automated Sciences Group, Inc., 8555 16th St., Suite 713, Silver Spring, Md. 20910 HS-802 316
IS-4-00942 ersity of Michigan, Hwy. Safety Res. Inst., Huron y. and Baxter Rd., Ann Arbor, Mich. 48109	HS-802 261	DOT-HS-6-01372 Calspan Corp., 4455 Genesee St., Buffalo, N.Y. 14221 HS-802 265
ersity of Michigan, Hwy. Safety Res. Inst., Huron y. and Baxter Rd., Ann Arbor, Mich. 48109	HS-802 262	DOT-HS-6-01384 Teknekron, Inc., 4701 Sangamore Rd., Washington, D.C. 20016 HS-802 313
HS-4-00965 onal Safety Council, 444 N. Michigan Ave., Chicago, Ill. 1	HS-802 293	DOT-OS-201-05 North Carolina State Univ., Mechanical and Aerospace En- gineering Dept. HS-020 836
HS-4-00972 pan Corp., 4455 Genesee St., Buffalo, N.Y. 14221	HS-802 274	DOT-OS-40096 University of Tennessee, Transportation Center, Knoxville, Tenn. 37916 HS-020 786
HS-5-01097 artment of Commerce, Inst. for Telecommunication nces, Boulder, Colo. 80302	HS-802 108	DOT-OS-50113 University of Michigan Regents, Ann Arbor, Mich. HS-020 708
artment of Commerce, Inst. for Telecommunication nces, Boulder, Colo. 80302	HS-802 109	

HPR-PR-1(12)-B0149-1A

Department of Motor Vehicles, Office of Program Devel.
and Evaluation, P.O. Box 1828, Sacramento, Calif. 95809

HS-020 689

HPR-1(14)-1

Purdue Univ., Joint Hwy. Res. Proj., West Lafayette, Ind.
47907

HS-020 759

Purdue Univ., Joint Hwy. Res. Proj., West Lafayette, Ind.
47907

HS-020 760

NASA-C-79821-C

CTL-Dixie Inc., 1240 Glendale-Milford Rd., Cincinnati, Ohio
45215

HS-020 749

NBS-6-9011

University of Michigan, Hwy. Safety Res. Inst., Ann Arbor,
Mich. 48109

HS-020 787

NHTSA-6-5801

Department of Transportation, National Hwy. Traffic Safety
Administration

HS-802 335

NSF-GI-44379

University of California - Berkeley, Dept. of Mechanical
Engineering

HS-020 761

SBTD-74-4601

IFM Akustikbyran AB, Sweden

HS-020 843

SBTD-74-4745

IFM-Akustikbyran AB, Sweden

HS-020 841

SR01-AM-16869

University of Michigan, Hwy. Safety Res. Inst., Huron
Pkwy. and Baxter Rd., Ann Arbor, Mich. 20014

HS-020 709

ASGI-TR-76-22	HS-802 316	NASA-TN-D-8363	HS-020 750
ASME-73-ICT-24	HS-020 753	NHTSA-TN-N43-32-2	HS-802 285
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BMCS-76-8	HS-020 784	ORNL-NSF-EP-15	HS-020 754
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CC-ZM-5566-V-3	HS-802 274	PB-263 077	HS-020 751
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CC-ZR-5954-V-1	HS-802 265	SAE-760553	HS-020 717
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DOT-TSC-OST-76-64	HS-020 751	SAE-760559	HS-020 721
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JHRP-77-7	HS-020 759	SAE-760569	HS-020 730
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MTP-391	HS-020 752	SAE-760571	HS-020 731
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SAE-760574		SAE-762004	HSL 77
	HS-020 735		HS-020
SAE-760575		SAE-762005	HS-020
	HS-020 736		HS-020
SAE-760581		SAE-762006	HS-020
	HS-020 737		HS-020
SAE-760583		SAE-762007	HS-020
	HS-020 738		HS-020
SAE-760584		SAE-762008	HS-020
	HS-020 739		HS-020
SAE-760585		SAE-762009	HS-020
	HS-020 740		HS-020
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SAE-760587		SAE-762012	HS-020
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	HS-020 745		HS-020
SAE-760603		SAE-762016	HS-020
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SAE-760608		SAE-762017	HS-020
	HS-020 747		HS-020
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	HS-020 765		HS-020
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	HS-020 766		HS-020
SAE-762000		SAE-762026	HS-020
	HS-020 813		HS-020
SAE-762001		SAE-762027	HS-020
	HS-020 814		HS-020
SAE-762002		SAE-762028	HS-020
	HS-020 815		HS-020
SAE-762003			HS-020

SAE-762030	HS-020 845	UM-HSRI-76-26-2	HS-020 692
SAE-762031	HS-020 846	UM-HSRI-76-30-1	HS-802 257
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SAE-770180	HS-020 702	5207	HS-802 313
SASI-77-521	HS-020 706		
SB-15	HS-802 306		
SP413	HS-020 702		
TARU-1/76	HS-020 712		
TARU-2/76	HS-020 713		
TARU-5/75	HS-020 711		
TARU-5/76	HS-020 714		
TARU-6/76	HS-020 715		
TARU-7/76	HS-020 716		
TC-76-018	HS-020 786		
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UM-HSRI 77-7	HS-020 767		
UM-HSRI-BI-75-8	HS-020 709		
UM-HSRI-76-12-2	HS-802 261		

CONTRACTS AWARDED

DOT-HS-7-01574

TRAFFIC SAFETY PROGRAMS/MANAGEMENT INFORMATION SYSTEM-DATA CONVERSION

Data conversion shall be performed for the Traffic Safety Programs/Management Information Systems (TSP/MIS), a system that provides program managers with data needed to manage their highway safety programs effectively. The first task to be performed is the logging of each of the four (4) data collection documents (Standards Status, Program Information Data, States Statistics Summary, Administrative Evaluation Data) submitted by each jurisdiction (States, territories, etc.) to insure complete reporting by each participating jurisdiction. The second task entails coding of Program Information and State Statistics Summary, and keypunching and verifying standard 80 column cards on EAM Card Punch and Verifier equipment for alpha, numeric, and alphanumeric requirements.

"This contract is awarded by the Small Business Administration under the authority of Section 8(a) of the Small Business Act (USC 637a), and will be administered by the Department of Transportation, National Highway Traffic Safety Administration."
\$14,821.00

To be completed three (3) months from date of contract award.

DOT-HS-7-01570

50TH PERCENTILE MALE ANTHROPOMORPHIC DUMMY IN ACCORDANCE WITH PART 572 OF MOTOR VEHICLE SAFETY STANDARD NO. 208, DATED SEPTEMBER 1, 1973

Two (2) 50th percentile male anthropomorphic dummies in accordance with Part 572 of Motor Vehicle Safety Standard Co. 208, dated September 1, 1973, shall be supplied.0aff

Humanoid Systems, 747 E. 223rd Street, Carson, Ca. 90745
\$11,880.00

To be completed thirty (30) days from date of contract award.

DOT-HS-7-01569

COMPLIANCE CHARACTERISTICS OF THE HUMAN CHEST DURING CARDIOPULMONARY RESUSCITATION

Compliance characteristics of the human chest during cardiopulmonary resuscitation shall be obtained. For each subject that dynamic data are recorded, the following descriptors shall be obtained: I.D. number, age, weight, sex, stature, axilla chest depth, axilla chest breadth, axilla chest circumference, substernale chest depth, substernale chest breadth, substernale chest circumference, and a quantitative description of all thoracic trauma present prior to (if determinable) and subsequent to cardiopulmonary resuscitation and an evaluation by

the attending physician as to the probability that the trauma was a result of the resuscitation. 0ing

The Johns Hopkins University, 34th and Charles Streets,
Baltimore, Maryland 21218
\$56,035.00

To be completed twelve (12) months from date of contract award.

DOT-HS-7-01568

50TH PERCENTILE MALE ANTHROPOMORPHIC DUMMY IN ACCORDANCE WITH PART 572 OF MOTOR VEHICLE SAFETY STANDARD NO. 208, DATED SEPTEMBER 1, 1973

Two (2) 50th percentile male anthropomorphic dummies in accordance with Part 572 of Motor Vehicle Safety Standard No. 208, dated September 1, 1973, shall be supplied. 0 ax

Sierra Engineering Co., Div. of CapTech Inc., 123 East Montecito Avenue, Sierra Madre, Los Angeles Co., Ca. 91024
\$11,370.00

To be completed thirty (30) days from date of contract award.

DOT-HS-7-01538

ON-ROAD DETECTION OF DWI'S

A two-phase effort shall be undertaken, the major objective of which is to increase the effectiveness of police visual inspection techniques for detecting DWI's (driving while intoxicated) by identifying potentially useful cues and on-the-road procedures. During Phase I, those on-the-road DWI visual detection procedures and cues, which may be obtained from the highway safety literature, expert opinion and selected DWI records, so as to identify visual cues and procedures already used and potentially useful, shall be reviewed. Also, during this phase, an on-the-road study, using police under varying conditions (i.e., night, weekends) which may be associated with high DWI apprehension, shall be implemented to answer a number of questions concerning such issues as current inspection accuracy, the relation between visual cues and BAC (blood alcohol concentration), etc. A second phase (Phase II) shall be initiated in the field to determine the impact of relevant strategies and detection cues identified in Phase I, on improving inspection accuracy. In addition, a Police Traffic Manual shall be developed which contains suggested procedures and identified clues for detecting DWI's. Finally, an operational and/or implementation plan for state and local law enforcement agencies shall be developed as part of this phase. 0en

Anacapu Sciences, Inc., 1528 Chapala Street, Santa Barbara, California 93102
\$271,834.00

To be completed twenty-four (24) months from date of contract award.

DOT-HS-7-01517

MEDICAL SERVICES FOR ENGINEERING TEST FACILITY PERSONNEL

Medical services shall be provided for government employees as requested by the Director, Engineering Test Facility in East Liberty, Ohio. Terms and conditions of examinations are as follows: periodic medical examinations for employees over age 40 and for employees with special duties, e.g., test car driving (examinations to include tonometry for glaucoma, protosig-moidoscopy or pelvic exam and Papanicolaou smear (as appropriate), electrocardiogram serology, complete urinalysis, and a complete blood count including white-blood cell count, differential and hemoglobin and/or hematocrit determination, and other tests such as cholesterol, BUN, and blood sugar—all as covered in Subchapter S4, Medical Standards of the Federal Personnel Manual, Supplement 792-1); emergency treatment of illness or injury on the job (to include emergency diagnosis and first treatment of injury or illness that become necessary during working hours regardless of whether the injury was sustained by the employee while in the performance of duty or whether the illness was caused by his/her employment); and immunization programs (e.g., for influenza and tetanus).0tin

Zaugg and Linscott, M.D.'s, Inc., 225 Stocksedale Drive, Marysville, Ohio 43040
Not to exceed \$2,000.00
To be completed one (1) year from date of contract award.

DOT-HS-6-01478 Mod. 3

STANDARD ENFORCEMENT TESTING PROGRAM TESTING OF PASSENGER VEHICLES FOR COMPLIANCE WITH FMVSS NOS. 219 AND 301.75

Testing of passenger vehicles in accordance with FMVSS Nos. 219 and 301.75 shall modified as follows: add accelerometers to vehicles and provide pre- and post-crash test data for vehicles to be tested (Article 1, Item 5); in all Task 1 tests, use SAF J211a class 60 filters to filter the resulting data from the accelerometers (see figures for positioning of accelerometers); in Task 2, take pre- and post-crash dimensions for each vehicle in frontal oblique crash tests (see figures); and include data from Tasks 1 and 2 in the scheduled final report.

Dynamic Science, Inc., 1850 W. Pinnacle Peak Road, Phoenix, Arizona 85027
Increased \$488.00
No change

DOT-HS-6-01477 Mod. 2

STANDARD ENFORCEMENT TESTING PROGRAM TESTING OF PASSENGER VEHICLES FOR COMPLIANCE WITH FMVSS NOS. 219 AND 301-75

In testing of passenger vehicles in accordance with FMVSS Nos. 219 and 301-75 shall be modified as follows: add accelerometers to vehicles and provide pre- and post-crash test data for vehicles to be tested (Article 1, Item 5); in all Task 1 tests, use SAF J211a class 60 filters to filter the resulting data from the accelerometers (see figures for positioning of accelerometers); in Task 2, take pre- and post-crash dimensions

for each vehicle in frontal or oblique crash tests (see figures); and include data from Tasks 1 and 2 in the scheduled final report.

Approved Engineering Test Laboratories, 1536 East Valencia Drive, Post Office Box 4158, Fullerton, California
Increased \$575.00 for each vehicle to be tested.
No change

DOT-HS-6-01462

SAFE PERFORMANCE SECONDARY SCHOOL DRIVER EDUCATION CURRICULUM DEMONSTRATION PROJECT

The Safe Performance Secondary School Driver Education Curriculum shall be demonstrated. Secondary school students eligible for driver education in the participating school district(s) will be randomly assigned to groups receiving instruction the Safe Performance Curriculum (SPC); the Pre-Driver Licensing Course (PDL), a minimal skills course aimed at developing those driving instruction in the secondary school. After completion of the instructional program, the driving records of students in the three groups will be monitored for two years to determine differences in crash and conviction rates for the three groups. The primary objective of this project is to determine the crash reduction potential of the SPC in the secondary school. The secondary objectives are to confirm the instructional effectiveness of the SPC and to confirm the reliability of the short-term performance measures and determine their correspondence with subsequent real-world driving experience. 0 wh

DeKalb County School System, 3770 N. Decatur Road, Decatur, Georgia 30032
\$2,999,876.00
To be completed six (6) years from date of contract award.

DOT-HS-6-01448 Mod. 2

FORD PINTO STEERING GEAR TEST AND EVALUATION

A chuckhole course shall be constructed over which a selected vehicle model shall be driven. Tasks to be performed over this course include the following: using identical steering gear and shock absorbers as in Test No. 1, drive over the chuckhole course a total of three hundred (300) times, begin driving fifty (50) cycles in the direction which is clockwise over the chuckhole section, then drive fifty (50) cycles in the opposite direction and continue to reverse direction after each group of fifty (50) cycles (force characteristics of the front shock absorbers established prior to their use); drive over the chuckhole course three hundred (300) times in the previously described manner using the steering gear and shock absorbers specified for Test No. 4; and repeat, using the steering gear and shock absorbers specified for Test No. 6. Those test runs performed with degraded shock absorbers listed in Item IV, Test Events of the Statement of Work utilizing shock absorber code B and steering gear numbers 1, 2, and 3 shall be deleted.0 th

Dynamic Science Incorporated, 1850 West Pinnacle Peak Road, Phoenix, Arizona 85027
Increased \$495.00
Extended to 31 May 77

DOT-HS-614003 Mod. 1

INFLUENCE OF AERODYNAMIC DISTURBANCES ON VEHICLE HANDLING

Eight (8) crosswind fan modules (instead of the six originally proposed) and a remote operating station shall be constructed. Task III-B is deleted in its entirety. Task IV, Analysis and Conclusions, shall be reduced to that necessary to report on Task III-A, Calibration Tests, as described in PMW. 0ing

Systems Technology, Inc., 13766 S. Hawthorne Blvd.,
Hawthorne, California 90250
Increased \$36,366.00
No change

DOT-HS-4-00955 Mod. 3

EXPERIMENTAL FIELD TEST OF PROPOSED ANTI-CART-OUT TRAINING

Twelve (12) additional data analyses dealing primarily with detailed comparisons of Toledo and Akron child pedestrian accidents occurring during the pre- and post-training periods of an anti-dart-out training program shall be conducted. 0-A,

Applied Science Associates, Inc., Box 158, Valencia, Butler
County, Pennsylvania 16059
Increased \$12,849.00
Extended to 30 Apr 77

DOT-HS-6-01338 Task Order 3

ANALYSIS OF ON-ROAD FAILURE DATA

The objective of this task is to determine the nature of the on-road failure problem and its safety significance both in terms of accident causation and subsystem involvement. The primary analysis objective shall be to first compare the distribution of component faults between AAA (American Automobile Association), SSP (Safety Service Patrol), and ACM (Automobile Club of Maryland) and historical disablement data. In addition, the types, modes, and levels of vehicle system, subsystem and component failures shall be identified as a function of vehicle factors such as make, model, year, manufacturer, and mileage. Vehicle factor profiles shall be compared with the underlying population of each data set to determine sample bias (over- or under-representation) or anomalous vehicle problems. Anomalies shall be culled by make/model, manufacturer and year. The type of vehicle breakdowns shall be examined as a function of time of year and month. Each organization's data shall be analyzed independently although specific sample bias shall be explained. Accident data bases shall be queried relative to disabled vehicle involvement, and defect caused accident data shall be correlated with disablement factors. Several hundred cases are also available which have not been keypunched for automated processing. Component faults for these manual cases shall be compared to those on tape to assure representativeness of data analyzed. The accuracy and validity check shall be reviewed and assessed. Breakdown problems in other vehicle categories (i.e., trucks, buses, and motorcycles) shall also be scrutinized and the specific nature of breakdowns requiring actual tow services delineated.

"This contract is awarded by the Small Business Administration under the authority of Section 8(a) of the Small

Business Act (USC 637a), and will be administered by the Department of Transportation, National Highway Traffic Safety Administration."
\$7,421.80
To be completed two (2) months from date of task order award.

DOT-HS-5-01017 Task Order 4 Mod. 3

Two (2) additional car-to-car, head-on crash tests at 50 mph closing speed using dummies in air bag equipped and belt equipped selected vehicle models shall be conducted. In addition, one 50th percentile female dummy shall be refurbished and provided with load cells in each femur. 0e t

Calspan Corporation, Post Office Box 235, Buffalo, New York 14221
\$13,191
To be completed by 29 May 77

DOT-HS-5-01063 Task Order 7

RESTRAINT SYSTEMS EVALUATION PROJECT (RSEP)

Restraint Systems Evaluation Project (RSEP) cases shall be reviewed, designated information shall be extracted, extracted information shall be coded onto coding forms, and data shall be keypunched and verified via card mode. Objectives are as follows: to provide two (2) copies of a tape with coded information (tape to consist of the new tape with eighteen (18) columns of information merged with the existing tape of coded information on the RSEP cases); to provide a list of cases where there was no matching augmented tape case and of those non-matching cases in either tape; and to provide a tabulated total of the merged tape (team vs. police vs. interview) information on seat belt usage.

Opportunity Systems, Inc., 1330 Massachusetts Ave., N.W.,
Washington, D.C. 20005
\$12,310.00
To be completed by 15 Sep 77

DOT-HS-5-01121 Mod. 7

TRAFFIC LAWS ANNOTATED

The following shall be prepared: four hundred (400) copies of the fifth annual Supplement to Traffic Laws Annotated (TLA) originally published in 1972 and to include annotations of state traffic laws in effect as of January 1, 1978, including those in effect in the Commonwealth of Puerto Rico, as compared with Chapter 10, 11 and 15 of the latest edition of the Uniform Vehicle Code (UVC); four hundred (400) copies of the fourth annual supplement of Driver Licensing Laws Annotated (DLLA), first published in 1973 and to include annotations of state driver licensing laws in effect as of January 1, 1978, as compared with Chapter 6 of the latest edition of the UVC; a manuscript, in five (5) copies, including one suitable for presentation to a printer, of a Traffic Laws Commentary entitled "Rules of the Road Rated," based on the latest statutes enacted by the States, District of Columbia, and the Commonwealth of Puerto Rico as compared with Chapter 11 (Rules of the Road) of the latest edition of the UVC and rating state

traffic laws in effect as of December 31, 1976; a manuscript, in five (5) copies, including one suitable for presentation to a printer, of a Traffic Laws Commentary entitled "Suspension of License for Failure to Appear in Court," based on the latest licensing and arrest procedure laws enacted by the various states as of December 31, 1977, as compared with the latest edition of the UVC; a manuscript, in five (5) copies, including one suitable for presentation to a printer, of a Traffic Laws Commentary entitled "Homicide by Vehicles," based on the latest Homicide by Vehicle Laws enacted by the various states as of December 31, 1967, as compared with the latest edition of the UVC; a manuscript, in five (5) copies, including one suitable for presentation to a printer of a Traffic Laws Commentary entitled "Issuance of Probationary Licenses to Minors," based on the latest licensing laws pertaining to minors enacted by the various states as of December 31, 1977, as compared with the latest edition of the UVC; and sixty-five (65) copies of the six subcommittee Agendas used as the basis for considering and recommending changes to the UVC, with the changes containing the various proposals to revise the UVC and the recommendations adopted for submission to subsequent plenary sessions of the entire National Committee on Uniform Traffic Laws and Ordinances.

National Committee on Uniform Traffic Laws and Ordinances, 1776 Massachusetts Avenue, N.W., Washington, D.C. 20036

Increased \$80,000.00

Extended to 31 May 78

DOT-HS-5-01127 Delivery Order No. 4

COMPLIANCE TESTING--TIRES

Retreaded passenger car tires shall be tested in accordance with FMVSS No. 109 (paragraph S4.2.2.5), following the National Highway Traffic Safety Administration's (NHTSA) Laboratory Test Procedure TP-109-04 dated April 1, 1974

Compliance Testing, Inc., 1150 No. Freedom Street, Ravenna, Ohio 44266

\$8,460.00

No change

DOT-HS-5-01214 Mod. 3

RESEARCH SAFETY VEHICLE. PHASE 2

In addition to providing assistance during display of the Calspan RSV (Research Safety Vehicle) Phase II Mockup at technical conferences, meetings, and other public exhibitions, technical explanations of the Calspan RSV shall be provided at such displays by supplying technical personnel and technical literature. Also, upon award of the Phase II contract modification for air bag development, the front seat restraint system of the Phase II Mockup shall be modified to illustrate both type restraint systems being developed. The air bag restraint shall be installed in the driver position; the passive air belt shall continue in the passenger position. A modified selected vehicle model driver system steering wheel shall be installed. The passive air belt shall be installed in the passenger position.

be replaced with a lap belt that does not require the belt to be placed on the dash mounted hook.

Calspan Corporation, Post Office Box 235, Buffalo, New York 14221

Increased \$24,996.00

No change

DOT-HS-5-01132 Mod. 3

HEAD MODEL INJURY CRITERIA DEVELOPMENT

Additional tasks to be performed in the development of head model injury criteria shall include the following: investigate techniques for improving the simulation of the brain model and evaluate four changes in the human brain model (the split energy interface elements, the addition of a single layer skull, split energy elements for the entire brain, and changes in brain material bulk modulus); analyze two (2) vibration tests from AFRRRI and digitize displacement data from test films; compare brain model pressures to pressures measured in HSRI (Highway Safety Research Institute) primate impact tests, stain approximate head accelerations for HSRI Tests Nos. 084 and 085 using the lumped parameter primate brain model and the measured impact force (accelerations will be input to the existing primate brain model and selected primate models developed, measured and computed pressures will be compared); measure cadaver brain pressures for correlation with model stresses (brain pressures inside four (4) pressurized unembalmed cadaver heads during impact at UCSD (University of California at San Diego) measured at six (6) subrural locations); simulate the UCSD cadaver tests (five (5) tests where pressure was measured, and ten (10) tests reported at the 20th Stapp Car Crash Conference) using an improved human brain model developed as described above; and write a report describing the model and evaluating possible improvements. 0g o

Civil Engineering Laboratory, Naval Construction Battalion Center, Port Huenemea, California 94043, Attn. J. C. Gomez

Increased \$110,000.00

Extended to 30 Oct 77

DOT-HS-5-01138 Delivery Order No. 7

TESTING OF MOTOR VEHICLE LAMPS, REFLECTIVE DEVICES AND ASSOCIATED EQUIPMENT

Mechanical tests (vibration phase) shall be conducted on passenger vehicle lamps, reflective devices and associated equipment in accordance with FMVSS No. 108 (National Highway Traffic Safety Administration (NHTSA) Laboratory Test Procedure TP-108-06 dated September 11, 1975). 0 sp

Ball Brothers Research Corporation, Aerospace Division, Post Office Box 1062, Boulder, Boulder County, Colorado 80302

\$1,205.00

No change

CRITICAL INCIDENT STUDY OF VEHICLE CRASH AVOIDANCE SYSTEMS

Pilot test data in critical incident study of vehicle crash avoidance systems shall be further analyzed to include the following: identify special areas of interest that could be examined using the pilot test data; analyze all data with respect to the special areas of interest identified above; compare near accident experiences to existing accident data and relate accident avoidance response data on ongoing crash avoidance studies; and include the results and analysis of the pilot test data in the final report.

Dunlap and Associates, Inc., 7730 Herschel, Suite F, La Jolla, California 92037, Attn: Dr. Clyde Briction
Increased \$15,242.00
Extended to 28 Feb 77

DOT-HS-5-01217 Mod. 6

STATE OF KNOWLEDGE AND INFORMATION NEEDS IN ALCOHOL/DRUGS AND HIGHWAY SAFETY

All available pertinent alcohol/drug highway safety data to be included as part of the final report shall be reviewed and evaluated. In addition to the final report, one (1) reproducible and five (5) reproduced copies of two (2) reports covering the alcohol phase of the project shall be provided. The first report will contain detailed technical material relating to alcohol and highway safety. The second report will present a summary version of the detailed technical material suitable for use as an information source by the general highway safety community (state and local governments, etc.). 0, s

The University of Michigan, 260 Research Admin. Bldg., Ann Arbor, Michigan 48105
Increased \$29,694.00
Extended to 1 May 77

DOT-HS-7-01576

AIR BRAKE MOBILE TEST LABORATORY

A Mobile Test Laboratory to test trucks, buses and trailers for compliance with FMVSS No. 121 which prescribes performance requirements for such vehicles that are equipped with air brake systems, shall be developed. The Mobile Laboratory would permit the National Highway Traffic Safety Administration (NHTSA), in carrying out its standard enforcement test program (SEF), to visit the manufacturing sites of many final stage manufacturers and trailer manufacturers and conduct the required equipment and vehicle performance tests. The Laboratory to be developed shall contain the following items: a portable brake actuation timer for trailers; a portable brake actuation timer for trucks, tractors, and buses; a fifth wheel and associated instrumentation to measure speed and stopping distance; a portable electronic instrumentation to measure vehicle compressor capability; a portable electronic instrument to measure the accuracy of the vehicle pressure gauge; a portable instrumentation that will determine the actuation pressure of the stop light switch; an instrument to calibrate all the above instruments; a self-contained air compressor and reservoir capable of meeting pressure and volume

electrical power from the vehicle battery; a rechargeable portable battery pack; a battery charging system; a set of mechanics tools capable of accomplishing required work on a typical vehicle air brake system; and a van capable of housing and supporting the laboratory equipment. In addition, operating instructions and service manuals and calibration procedures and calibration sheets for all equipment shall be provided. 0red

Nucleus Corporation, 25131 Dequindre, Madison Heights, Michigan 48071
\$41,718.00

To be completed five (5) months from date of contract award

DOT-HS-7-01577

TRAINING PROGRAM FOR THE NATIONAL ACCIDENT SAMPLING SYSTEM

A training program shall be developed which will satisfy the minimum needs of preparing personnel for field work and will provide a common training experience for all data collection personnel for the National Accident Sampling System (NASS). The functions of the NASS teams in each data collection site or primary sampling unit (PSU) shall include, but are not limited to, the following: case selection and sampling techniques, vehicle inspection, site inspection, interviewing, hospital record retrieval, case summary encoding, and team leadership. In addition, training related to the functioning of individuals as a team shall be included, as determined to be necessary by a task analysis, with emphasis being given to the operation of the organization, communications, authority and function relationships. Furthermore, training shall cover key aspects of NASS teams relationships with other local organizations (e.g., police) whose relationship is vital to the successful operation of the NASS team. This training shall cover, but not be limited to, the method of operation of the NASS team at its home site, its regional coverage, jurisdiction of NASS team and other community organizations in case investigations, working relationships with external organizations, relationships with the regional Zone Center, and other functional issues affecting the operation of the team.

Allen Corporation of America, 517 South Washington Street, Alexandria, Virginia 22314
\$99,995.00

To be completed thirty (30) months from date of contract award

DOT-HS-7-01582

STANDARDS ENFORCEMENT PROGRAM TESTING OF "SEATING SYSTEMS" IN ACCORDANCE WITH FMVSS NO. 207

Motor vehicles shall be tested in accordance with FMVSS. No. 207, Seating Systems (National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-207-07 dated October 1, 1975).the

Southwest Research Institute, 8500 Culebra Road, San Antonio, Texas 78284
Per Delivery Order

To be completed one (1) year from date of contract award

DOT-HS-7-01583

STANDARDS ENFORCEMENT PROGRAM TESTING OF "SEATING SYSTEMS" IN ACCORDANCE WITH FMVSS NO. 207

Motor vehicles shall be tested in accordance with FMVSS No. 207, Seating Systems (National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-207-07 dated October 1, 1975).

General Environments Corporation, 6840 Industrial Road,
Springfield, Virginia
Per Delivery Order
To be completed one (1) year from date of contract award

DOT-HS-7-01584

STANDARDS ENFORCEMENT TESTING PROGRAM TESTING OF PASSENGER VEHICLES FOR COMPLIANCE WITH FMVSS NO. 217

Buses (including school buses) shall be tested in accordance with FMVSS No. 217 (National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-217-02). 1.

Southwest Research Institute, 8500 Culebra Road, San Antonio, Texas 78234
Per Delivery Order
To be completed one (1) year from date of contract award

DOT-HS-7-01585

STANDARDS ENFORCEMENT TESTING PROGRAM TESTING OF PASSENGER VEHICLES FOR COMPLIANCE WITH FMVSS NO. 217

Buses (including school buses) shall be tested in accordance with FMVSS No. 217 (National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-217-02)

General Environments Corporation, 6840 Industrial Road,
Springfield, Virginia 22151
Per Delivery Order
To be completed one (1) year from date of contract award

DOT-HS-7-01586

STANDARDS ENFORCEMENT TESTING PROGRAM TESTING OF PASSENGER VEHICLES FOR COMPLIANCE WITH FMVSS NO. 214

Passenger vehicles shall be tested in accordance with FMVSS No. 214 (National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-214-01).

Southwest Research Institute, 8500 Culebra Road, San Antonio, Texas 78284
Per Delivery Order
To be completed one (1) year from date of contract award

DOT-HS-7-01587

STANDARDS ENFORCEMENT TESTING PROGRAM TESTING OF PASSENGER VEHICLES FOR COMPLIANCE WITH FMVSS NO. 214

Passenger vehicles shall be tested in accordance with FMVSS No. 214 (National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-214-01).

Minicars, Inc., 35 La Patera Lane, Goleta, California 93017
Per Delivery Order
To be completed one (1) year from date of contract award

DOT-HS-7-01588

LIGHTWEIGHT SUBCOMPACT VEHICLE SIDE STRUCTURE

A detailed design to modify the side structure of a lightweight subcompact automobile shall be developed and crash test (crush test, oblique side crash test). The objectives of study are the following: to improve side structure integrity vehicle-to-vehicle side impact collisions, to improve occupant compartment integrity in vehicle-to-vehicle or vehicle-to-object frontal offset collisions, and to establish structural improvement versus weight increases. The restrictions of modifications are as follows: total weight increase not to exceed 100 pounds (50 pounds per side), thickness of interior energy-absorbing material not to exceed three (3) inches exterior width dimensions to increase more than two inches, interior floor space to remain basically the same structural intrusions in foot well area that would sacrifice occupant comfort, occupant ingress not to be significantly altered, and structural modifications to be production and feasible, according to current production technology.

The Budd Company, Technical Center, 300 Commerce Drive
Fort Washington, Pennsylvania 19034
\$498,112.00
To be completed eighteen (18) months from date of contract award

DOT-HS-7-01595

WINDSHIELD WIPING AND WASHING SYSTEMS FOR PASSENGER CARS

Passenger cars shall be tested in accordance with FMVSS 104, Windshield Wiping and Washing Systems (National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure 104-04 dated September 16, 1974).

General Environment Corporation, 6840 Industrial Road,
Springfield, Virginia 22151
Per Delivery Order
To be completed one (1) year from date of contract award

September 30, 1977

DOT-HS-7-01595 Delivery Order No. 1

WINDSHIELD WIPING AND WASHING SYSTEMS-- PASSENGER CARS

Passenger cars shall be tested five (5) times, using video taping, in accordance with FMVSS No. 104, Windshield Wiping and Washing Systems (National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-104-04 dated September 16, 1974). c/c

General Environment Corporation, 6840 Industrial Road,
Springfield, Virginia 22151
\$5,225.00
No change

DOT-HS-7-01596

WINDSHIELD WIPING AND WASHING SYSTEMS-- PASSENGER CARS

Passenger cars shall be tested in accordance with FMVSS No. 104, Windshield Wiping and Washing Systems (National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-104-04 dated September 16, 1974, with the deletion of steps 6.4.2.2 through 6.4.2.10 of the Test Procedure, the performance of step 6.4.2.18 using layouts supplied by NHTSA, and the deletion of paragraphs 6.6, 6.7, 6.8, 6.9, and 6.10 of the Test Procedure).

Dynamic Science, Inc., 1850 W. Pinnacle Peak Road, Phoenix,
Arizona 85027
Per Delivery Order
To be completed one (1) year from date of contract award

DOT-HS-7-01596 Delivery Order No. 1

WINDSHIELD WIPING AND WASHING SYSTEMS-- PASSENGER CARS

Passenger cars shall be tested five (5) times, using video taping, in accordance with FMVSS No. 104, Windshield Wiping and Washing Systems (National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-104-04 dated September 16, 1974). o/c

Dynamic Science, Inc., 1850 W. Pinnacle Peak Road, Phoenix,
Arizona 85027
\$6,400.00
No change

DOT-HS-7-01597

SEAT BELT ASSEMBLY

Three (3) each Type II seat belt assemblies with emergency locking retractors shall be tested in accordance with FMVSS No. 209 (paragraphs S5.2J and K), following the National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-

DOT-HS-7-01598 Delivery Order No. 1

cycling and repeat of baseline performance, and retractor strength testing. . 6.

Dayton T. Brown, Inc., Church Street, Bohemia, New York
11716
Per Delivery Order
To be completed one (1) year from date of contract award

DOT-HS-7-01597 Delivery Order No. 1

SEAT BELT ASSEMBLY

Thirty-five (35) tests shall be performed on Type II seat belt assemblies with emergency locking retractors in accordance with FMVSS No. 209 (National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-209-01 dated June 1973).

Dayton T. Brown, Inc., Church Street, Bohemia, New Jersey
11716
\$21,665.00
No change

DOT-HS-7-01598

SEAT BELT ASSEMBLY

Three (3) each Type II seat belt assemblies with emergency locking retractors shall be tested in accordance with FMVSS No. 209 (paragraphs S5.2J and K), following the National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-209-01 dated June 1973 (paragraph H, 15, 16, 17, 18, 19, 20, and 21). Testing will comprise retractor baseline performance, cycling and repeat of baseline performance, and retractor strength testing the

United States Testing Company, Inc., 1415 Park Avenue,
Hoboken, New Jersey 07030
Per Delivery Order
To be completed one (1) year from date of contract award

DOT-HS-7-01598 Delivery Order No. 1

SEAT BELT ASSEMBLY

Thirty-five (35) tests shall be performed on Type II seat belt assemblies with emergency locking retractors in accordance with FMVSS No. 209 (National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-209-01 dated June 1973). 0F)

United States Testing Company, Inc., 1415 Park Avenue,
Hoboken, New Jersey 07030
\$21,000.00
No change

DOT-HS-7-01599

TRAFFIC SAFETY PROGRAMS/MANAGEMENT INFORMATION SYSTEMS

In the continuing development of the Traffic Safety Programs/Management Information Systems (TSP/MIS), additional modules to the total system, assistance to TSP personnel in accessing and manipulating the data, identification and correction of problem areas, and assistance in revising the design specifications during the implementation as required by TSP personnel shall be provided. The following tasks shall be performed: update Coordinators and Users Manual, Data Dictionary; load data, design and program additional annual reports, and update and refine instructions manual for the Program Information Data Module (PID); load data, design and program annual reports, design and program turnaround reports, and update users and coordinators manuals for the State Statistics Summary Data (SSSD) Module; restructure the State submissions to identify that information which is usable and to establish the apparent framework which the State should have used in sending their submissions initially, correct arithmetic errors other than obvious mistranscriptions, display and highlight omissions, and check submissions against other available headquarters data for the Administrative Evaluation Data Module (AED); develop and Administrative Evaluation Data Reporting Procedures Handbook; and prepare complete annual reports for each module of the TSP/MIS

Genasys Corporation, 11300 Rockville Pike, Rockville, Maryland 20852
\$80,256.00

To be completed twelve (12) months from date of contract award

DOT-HS-7-01602

TRUCK AND TRAILER YAW DIVERGENCE AND ROLLOVER

Truck and trailer yaw divergence and rollover shall be studied. Sys

The University of Michigan, Div. of Research Development and Admin., Research Admin. Bldg. - North Campus, Ann Arbor, MI 48105
\$217,545.00
To be completed by 19 Nov 78

DOT-HS-7-01607

DATA CONVERSION FOR NATIONAL DRIVER REGISTER

Data conversion of hard copy source documents to magnetic tape for the National Driver Register (NDR) shall be accomplished.

Informatics, Inc., 6811 Kenilworth Avenue, Riverdale, Maryland 20840
\$93,650.00
To be completed by 30 Apr 1978

DOT-HS-7-01609

TRUCK TIRE BRAKING AND CORNERING TRACTION STUDY

A variety of truck tires shall be tested in cornering and braking on a variety of surfaces, and a detailed tabulation of the data with an accompanying detailed recapitulation of the conduct of the test shall be provided. A sample of tires not less than twenty-five (25) samples in duplicate shall be tested in accordance with the following requirements: testing in straight ahead braking at 40 and 55 mph measuring the peak and slide braking coefficient, with rate of brake application approximately 0.3 sec to peak; in cornering, sweeping of tire from -2° to 020° steer angle free rolling, with recording of maximum lateral coefficient; use of an asphalt surface, SN 50 0/- 10 and a concrete surface, SN 30 0/- 5 (one water depth of 0.020 inch at least 15 inches wide); run each tire at 85% 0/- 5% of its maximum load; and testing of 25 tires x 2 duplicates x 10 repeats x 2 surfaces x 2 speeds x 1 water depth x 2 modes of test 4000 tests 0 a control to be run adjacent to every tire test, CTTCTTC...0 or

The University of Michigan, 260 Research Administration Building, Ann Arbor, Michigan 48105
\$99,940.00

To be completed ten (10) months from date of contract award

DOT-HS-7-01610

DOOR LOCKS AND DOOR RETENTION COMPONENTS

Door locks and door retention components of motor vehicles shall be tested in accordance with FMVSS No. 206 (National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-206-02 dated November 1973). 0-fi

Approved Engineering Test Lab., 1536 East Valencia Drive, Fullerton, California 92631
Per Delivery Order
To be completed six (6) months from date of contract award

DOT-HS-7-01611

DOOR LOCKS AND DOOR RETENTION COMPONENTS

Door locks and door retention components of motor vehicles shall be tested in accordance with FMVSS No. 206 (National Highway Traffic Safety Administration's (NHTSA) Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-206-02 dated November 1973)

Minicars, Inc., 35 La Patera Lane, Goleta, California 93017
Per Delivery Order
To be completed six (6) months from date of contract award

EXEMPLARY PROGRAMS INVOLVING THE USE OF SCHOOL BUSES

A study shall be conducted to identify exemplary transportation safety activities involving the use of school buses which meet established criteria, and a written report shall be submitted on these activities for use in assisting States and communities interested in developing similar activities. In-depth on-site investigations in selected jurisdictions shall be conducted to examine their overall pupil transportation programs and identify innovative activities within their programs. These activities shall be evaluated in relation to criteria established by the National Highway Traffic Safety Administration (NHTSA).

"This contract is awarded by the Small Business Administration under the authority of Section 8(a) of the Small Business Act (USC 637a), and will be administered by the Department of Transportation, National Highway Traffic Safety Administration."

\$49,100.00

To be completed nine (9) months from date of contract award

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY
ADMINISTRATION
Washington, D.C. 20590

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